SURFACE WATER QUALITY IN MAJOR ALBERTA RIVERS Fall-Winter 1982/83

Alberta

ENVIRONMENT

Pollution Control Division

Water Quality Control Branch

SURFACE WATER QUALITY
IN
MAJOR ALBERTA RIVERS
Fall-Winter 1982/83

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WATER QUALITY CONTROL BRANCH

TABLE OF CONTENTS

Summary i

Alberta Surface Water Objectives 1

Explanatory Notes 5

Location of Primary Monitoring Sites 9

River Water Quality

Oldman R. 10
Bow R. 20
S. Saskatchewan R. 30
Red Deer R. 41
Battle R. 60
N. Saskatchewan R. 71
Beaver R. 92
Athabasca R. 92
Smoky R. 104
Peace R. 104

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SUMMARY

This is the first of a series of proposed water quality reports for Alberta rivers. It is intended that these be produced three times a year.

The intention is to make the data available for the sixteen stations on major rivers that are sampled on a monthly basis and indicate the water quality levels.

In the fall and winter (83/84) of the 3341 parameters analysed 3317 met surface water objectives (99%). Those sites at which parameters did not meet objectives and the parameters not met were:

Oldman River at Hwy 36	Phosphorus, Total Coliforms
Bow River near mouth	Phosphorus, Nitrogen
South Saskatchewan River at Hwy 41	Phosphorus, Nitrogen
Red Deer River at Drumheller	Phosphorus, nitrogen, faecal coliforms
Red Deer River at Bindloss	Phosphorus, nitrogen
Battle River at Unwin	Phosphorus, nitrogen, oxygen
North Saskatchewan River at Pakan	Phosphorus, total coliforms, faecal coliforms
North Saskatchewan River at Lea Park	Phosphorus, total coliforms, faecal coliforms
Beaver River at Beaver Crossing	Phosphorus, nitrogen, oxygen
Smoky River at Watino	Phosphorus

Those parameters that exceeded surface water objectives were those associated with organic loading, that is nutrients, bacteria and oxygen. In the large rivers downstream of major centers this was most probably due to municipal sewage effluent, in the other rivers such as Battle and Beaver this was in part a result of naturally high organic loadings.

Low winter flows and lack of biological activity probably also contributed to high concentrations in the water column.

SURFACE WATER QUALITY OBJECTIVES

Surface water quality objectives represent water quality levels suitable for most uses either through direct use or prepared for use by an economically practical degree of treatment. The objectives apply to surface waters except in areas of close proximity to outfalls.

There are many instances where the natural water quality of a lake or river does not meet some of the suggested limits. In these cases, the limits obviously will not apply. Is should be noted, however, that where the natural existing quality is inferior to desirable criteria, it would be unwise to permit further deterioration by unlimited or uncontrolled introduction of pollutants. Naturally occurring circumstances are not taken into account in these objectives and due consideration must be given where applicable (e.g. spring runoff effect on colour, odour, etc.)

1. Bacteriology - Coliform Group

a) In waters to be withdrawn for treatment and distribution as a potable supply or used for outdoor recreation other than direct contact, at least 90 per cent of the samples (not less than five samples in any consecutive 30-day period) should have a total coliform density of less than 5,000 per 100 ml and a fecal coliform density of less than 1,000 per 100 ml.

b) In waters used for direct contact recreation or vegetable crop irrigation, the geometric mean of not less than five samples taken over not more than a 30-day period should neither exceed 1,000 per 100 ml total coliforms nor 200 per 100 ml fecal coliforms. Also, these numbers should neither be exceeded in more than 20 per cent of the samples examined during any month nor 2,400 per 100 ml total coliforms on any day.

2. Dissolved Oxygen

A minimum of five mg.L at any time.

3. Biochemical Oxygen Demand

Dependent on the assimilative capacity of the receiving water, the BOD must not exceed a limit which would create a dissolved oxygen content of less than five mg.L.

4. Suspended Solids

Not to be increased by more than 10 mg.L over background value.

5. pH

To be in the range of 6.5 to 8.5 pH units but not altered by more than 0.5 pH units from background value.

6. Temperature

Not to be increased by more than 3°C above ambient water temperature.

7. Odour

The cold (20°C) threshold odour number not to exceed eight.

8. Colour

Not to be increased more than 30 colour units above natural value.

9. Turbidity

Not to exceed more than 25 Jackson units over natural turbidity.

10. Organic Chemicals

Constituent	Maximum Concentration (mg.L)
Carbon Chloroform Extract (CCE) (includes Carbon Alcohol Extract)	0.2
Methyl Mercaptan	0.05
Methylene Blue Active Substances	0.5
Oil and Grease	substantially absent, no irridescent sheen
Phenolics	0.005
Resin Acids	0.1

11. Pesticides

To provide reasonably safe concentrations of these materials in receiving waters, an application shall not exceed 1/100 of the 48-hour TL_m. No pesticides can be used in Alberta unless they have been registered under the Pest Control Products Act. Any pesticides used on, in, or near water (within 100 linear feet) must be approved by a Department of Environment permit issued under The Agricultural Chemicals Act.

12. Toxic Chemicals

Constituent	Maximum Concentration (mg.L)
Arsenic	0.01
Barium	1.0
Cadmium	0.01
Chromium	0.05
Cyanide	0.01
Lead	0.05
Mercury	0.0001
Selenium	0.01
Silver	0.05

13. Radioactivity

Gross Beta not to exceed 1,000 pCi/l.

Radium 226 not to exceed three pCi/l.

Strontium 90 not to exceed 10 pCi/l.

14. Inorganic Chemicals

Constituent	Maximum Concentration (mg.L)
Boron	0.5
Copper	0.02
Fluoride	1.5
Iron	0.3

Constituents	Maximum Concentration (mg.L)
Manganese	0.05
Nitrogen (Total Inorganic and Organic)	1.0
Phosphorus as PO_4 (Total Inorganic and Organic)	0.15
Sodium (as precent of cations)	between 30 & 70
Sulphide	0.05
Zinc	0.05

NOTE: The predominant cations of SODIUM, CALCIUM and MANGANESE and anions of SULPHATE, CHLORIDE and BICARBONATE are too variable in the natural water quality state to attempt to define limits. Nevertheless, in order to prevent impairment of water quality and where effluents containing these ions are discharging to a water body, the permissible concentration will be determined by the administrative authority in accordance with existing quality and use.

15. Unspecified Substances

Substances not specified herein should not exceed values which are considered to be deleterious for the most critical use as established by the administrative authority.

EXPLANATORY NOTES FOR PARAMETERS IN THE WATER QUALITY OBJECTIVES

1. Biochemical Oxygen Demand

   Usually a five-day, 20°C test (BOD_5). This parameter is a measure of organic matter and thereby a measure of the degree of organic pollution.

2. Boron

   Is harmful to boron sensitive plants and may have a long-term effect on health if ingested in large amounts over protracted time.

3. Carbon Chloroform Extract (CCE) and Carbon Alcohol Extract (CAE)

   A measure of organic material such as insecticides, pesticides, herbicides and synthetic industrial chemicals which are toxic in trace quantities.

4. Coliform Bacteria

   Used as an indicator of the bacteriological quality of water as related to the possible presence of disease producing organisms.

   Fecal coliforms are less likely to grow outside the intestinal tract of warm blooded animals and are somewhat less hardy than the total coliforms.

5. Colour

   Causes undesirable aesthetic effect on water used for domestic supplies and is detrimental for various industrial processes.

6. Copper (Cu)

   Imparts an undesirable taste in drinking water, is objectionable for canning and is toxic to fish and aquatic life.

7. Dissolved Oxygen (DO)

   The effect of organic pollution is reflected in the resulting depletion of DO; an adequate level of DO is required to maintain a proper balance of fish and aquatic life for natural river purification and to prevent anaerobic conditions.

8. Fluoride (F)

   Optimum concentrations of fluoride in drinking water will reduce dental cavities whereas excessive amounts will induce dental fluorosis.

9. Iron (Fe)

Stains laundry and plumbing fixtures, imparts taste and interferes with ion exchange units.

10. Manganese (Mn)

Stains laundry and plumbing fixtures and is undesirable in many industrial processes even in low concentrations.

11. Methylene Blue Active Substances (MBAS)

A term used to describe synthetic detergents and the method of detection. Stynthetic detergents reduce the rate of re-aeration, may cause taste in water supplies, are toxic to fish in high concentrations and cause foaming.

12. Methyl Mercaptan

In low concentrations cause taste and odour and are toxic to fish.

13. Nitrogen

A nutrient for plant growth. Ammonia nitrogen (NH_3N) creates oxygen demand, indicates pollution, can be toxic to fish and interferes with water treatment and brewing. Nitrate (NO_3) levels in excess of 40 mg.L as nitrate can be harmful to infants.

14. Oil and Grease (Ether Solubles)

Objectionable from an aesthetic standpoint, reduce re-aeration, are toxic to fish, taint fish flesh, create taste and odours and interfere with water treatment and water fowl.

15. Pesticides

Term used synonomously with biocides but generally refers to chlorinated hydrocarbon and organo-phosphorus chemicals.

16. pH

Measure of intensity of acidity or alkalinity and related to taste, corrosiveness, efficiency of chlorination, coagulation and suitability of industrial application.

17. Phenolics

Minute concentrations impart a taste to water which is intensified by chlorination; small amounts taint fish flesh.

18. Phosphorus

A nutrient for plant growth, interferes markedly with coagulation, often measured as phosphate (PO_4).

19. Radioactivity

Is especially significant in relation to human health, first through the direct consumption of water and second through the ingestion of agricultural products, stock and aquatic life that have accumulated radioactivity.

20. Resin Acids

Can be toxic to fish.

21. Sodium (Na)

In combination with sulphate causes a laxative effect and boiler foaming, undesirable for people on a salt free diet and detrimental for irrigation.

22. Sodium (as percent of cations) -- % Na

A measure of the suitability of water for irrigation.

23. Sulphate (SO_4)

Can be toxic to fish, causes taste and odours and is detrimental for industrial use.

24. Suspended Solids (SS)

A measure of material exceeding colloidal size. These solids interfere with self-purification, lead to sludge deposits, damage fisheries and create a nuisance aesthetically.

25. Temperature

Affects palability, water treatment, industrial processes, self-purification and aquatic life.

26. Threshold Odour Number (TON)

Measure of taste and odour producing substances in water; high concentations of odour require extensive treatment.

27. $T1_m$

Median tolerance limit or the concentration that kills 50 percent of the test organisms within a specified time span, usually 48 hours or less.

28. Toxic Chemicals

Often related to heavy metals. These include arsenic (As), barium (Ba), cadmium (Cd), chromium (Cr), cyanide (CN), lead (Pb), mercury

(Hg), nickel (Ni), selenium (Se), and silver (Ag). Because of the ability of organisms to concentrate these chemicals and because of their toxicity to humans in minute amounts, the concentration of any toxic chemical must be kept very low.

29. Turbidity

A measure of the colloidal and suspended solids load, it has a bearing on asesthetics, water treatment, aquatic life and industrial use.

30. Zinc

Produces an undesirable taste and can be synergistic.

NORTHWEST TERRITORIES
BRITISH COLUMBIA
SASKATCHEWAN
MONTANA
ROCKY MOUNTAINS
MEANDER RIVER
FORT VERMILION
PEACE RIVER
MANNING
SPIRIT RIVER
GRANDE PRAIRIE
HIGH PRAIRIE
SWAN HILLS
ATHABASCA
FORT McMURRAY
COLD LAKE
ST PAUL
WHITECOURT
WESTLOCK
EDSON
EDMONTON
LLOYDMINSTER
DRAYTON VALLEY
WETASKIWIN
CAMROSE
WAINWRIGHT
JASPER
RED DEER
CORONATION
SUNDRE
DRUMHELLER
CALGARY
BROOKS
CLARESHOLM
MEDICINE HAT
LETHBRIDGE
CARDSTON
● MONITORING SITES

SOUTH SASKATCHEWAN RIVER BASIN - OLDMAN RIVER

For the Oldman River above Lethbridge and at Highway 36, most parameters met surface water objectives. The exceptions were total phosphorus and total coliforms. Total phosphorus exceeded objectives on all sampling occasions at Highway 36 (Table 2) and on one occasion, March, above Lethbridge. One high total coliform value was observed above Lethbridge in January (Table 4).

Parameters that showed some change between stations were nutrients: total and soluble phosphorus, total and dissolved nitrogen (Tables 2 & 3), all of which were consistently higher at the downstream station. Total coliforms and fecal streptococci were also higher at the downstream stations. These changes most likely resulted from municipal discharges of the City of Lethbridge.

The last sampling occasion in March reflected the occurrence of spring runoff. The sediment load was considerably higher, as indicated by the higher turbidity and residues (Table 1). Associated with this were elevated levels of phosphorus, which were due almost entirely to particulate material transported by sediments.

TABLE 1

OLDMAN RIVER
(All values in mg.L unless otherwise noted)

ABOVE LETHBRIDGE

	OXYGEN	CONDUCTIVITY (us/cm)	PH (pH units)	TEMPERATURE (Deg C)	TURBIDITY (JTU)	COLOUR (Rel Units)	RESIDUE N.F.
NOV	12.8	337.	8.2	1.5	9.0	10.	10.
DEC	13.0	394.	8.2	0.5	3.5	L5.	5.
JAN	14.1	363.	NV	4.0	3.2	L5.	6.
FEB	13.7	306.	8.7	0.0	3.0	5.	4.
MAR	12.0	389.	8.2	6.0	25.	30.	19.

HWY 36 - TABER

	OXYGEN	CONDUCTIVITY (us/cm)	PH (pH units)	TEMPERATURE (Deg C)	TURBIDITY (JTU)	COLOUR (Rel Units)	RESIDUE N.F.
NOV	13.6	362.	8.2	1.5	10.0	5.	7.
DEC	12.1	448.	8.1	1.5	2.5	10.	2.
JAN	15.6	401.	8.5	0.5	4.0	L5.	3.
FEB	13.4	393.	8.4	1.5	3.5	10.	2.
MAR	12.4	332.	8.3	3.5	32.	20.	38.

OBJECTIVE G5.0

G greater than
L less than
* unusual value
NV no value
F field filtered
L lab filtered

TABLE 2

OLDMAN RIVER
(All values in mg.L unless otherwise noted)

ABOVE LETHBRIDGE

	PHOSPHORUS (Total as P)	PHOSPHORUS (Total Soluble)	PHOSPHORUS (Particulate)	NITROGEN (Tot Ammonia as N)	NITROGEN (Diss as N)L
NOV	0.012	L0.003	0.010	L0.1	0.11
DEC	0.009	L0.003	0.007	L0.1	0.15
JAN	0.010	L0.003	0.008	L0.1	0.15
FEB	0.013	0.011	L0.006	L0.1	0.12
MAR	0.15	0.008	0.14	L0.1	0.04

HWY 36 - TABER

	PHOSPHORUS (Total as P)	PHOSPHORUS (Total Soluble)	PHOSPHORUS (Particulate)	NITROGEN (Tot Ammonia as N)	NITROGEN (Diss as N)L
NOV	0.055	0.022	0.033	L0.1	0.13
DEC	0.088	0.063	0.025	0.3	0.44
JAN	0.076	0.072	L0.006	0.1	0.33
FEB	0.15	0.13	0.02	L0.1	0.35
MAR	0.14	0.039	0.10	L0.1	0.18

OBJECTIVE	0.05	-	-	-	-

TABLE 3

OLDMAN RIVER
(All values in mg.L unless otherwise noted)

ABOVE LETHBRIDGE

	NITROGEN (Diss NO_3 + NO_2 as N)	NITROGEN (Total as N)	NITROGEN (Diss as N)F	NITROGEN (Part as N)L	CARBON (Diss Org as C)L
NOV	0.05	0.11	0.11	L0.01	1.4
DEC	0.15	0.15	0.15	L0.01	1.3
JAN	0.08	0.18	0.15	0.03	1.5
FEB	0.07	0.16	0.11	0.04	1.8
MAR	0.04	0.23	0.18	0.04	2.7

HWY 36

	NITROGEN (Diss NO_3 + NO_2 as N)	NITROGEN (Total as N)	NITROGEN (Diss as N)F	NITROGEN (Part as N)L	CARBON (Diss Org as C)L
NOV	0.01	0.23	0.23	0.10	1.7
DEC	0.19	0.44	0.47	L0.01	1.7
JAN	0.21	0.37	0.34	0.04	1.6
FEB	0.25	0.44	0.38	0.09	1.6
MAR	0.09	0.51	0.17	0.33	2.0

OBJECTIVE	1.0

TABLE 4

OLDMAN RIVER
(All values in mg.L unless otherwise noted)

ABOVE LETHBRIDGE

	CARBON (Part Org as C)L	PHENOLICS	TOTAL COLIFORMS (no. 100 mL)	FECAL STREPTOCOCCUS (no. 100 mL)	FECAL COLIFORMS (no. 100 mL)
NOV	0.38	0.001	80.	114.	13.
DEC	0.19	L0.001	8.	78.	2.
JAN	0.19	L0.001	1020.	380.	130.
FEB	0.25	0.002	120.	29.	L2.
MAR	0.27	0.003	2.	320.	L2.

HWY 36

	CARBON (Part Org as C)L	PHENOLICS	TOTAL COLIFORMS (no. 100 mL)	FECAL STREPTOCOCCUS (no. 100 mL)	FECAL COLIFORMS (no. 100 mL)
NOV	1.7	0.001	180.	980.	17.
DEC	0.21	L0.001	440.	510.	118.
JAN	1.6	0.003	70.	63.	14.
FEB	0.47	0.001	10.	900.	7.
MAR	2.0	0.002	L2.	500.	L2.

OBJECTIVE		0.005	1000		200

TABLE 5

OLDMAN RIVER
(All values in mg.L unless otherwise noted)

ABOVE LETHBRIDGE

	ALKALINITY	HARDNESS (Total as $CaCO_3$)	MAGNESIUM	CALCIUM	POTASSIUM	SODIUM	SILICA (Reactive)
NOV	140.	166.1	15.6	40.8	1.2	13.	2.7
DEC	155.	168.9	15.6	41.9	0.9	10.	2.4
JAN	140.	163.8	15.1	40.7	0.9	11.	2.2
FEB	130.	150.6	13.7	37.7	0.9	10.	1.8
MAR	140.	158.2	14.9	38.8	1.6	17.	2.6

HWY 36 - TABER

	ALKALINITY	HARDNESS (Total as $CaCO_3$)	MAGNESIUM	CALCIUM	POTASSIUM	SODIUM	SILICA (Reactive)
NOV	140.	168.0	15.7	41.4	1.3	16.	1.3
DEC	172.	201.5	18.3	50.5	1.6	19.	1.1
JAN	150.	180.9	16.4	45.4	1.4	16.	0.8
FEB	155.	177.7	16.1	44.6	1.6	18.	L0.1
MAR	125.	145.9	13.6	36.0	1.3	18.	0.1

OBJECTIVE

TABLE 6

OLDMAN RIVER
(All values in mg.L unless otherwise noted)

ABOVE LETHBRIDGE

	FLUORIDE	CHLORIDE	SULPHATE	CARBONATE	BICARBONATE	HYDROXIDE	TOTAL DISSOLVED SOLIDS
NOV	0.14	1.4	39.	0.0	170.7	0.0	198.1
DEC	0.09	1.6	40.	0.0	188.9	0.0	206.2
JAN	0.10	1.6	41.	0.0	170.7	0.0	197.0
FEB	0.08	1.6	40.	0.0	158.5	0.0	184.1
MAR	0.10	2.2	48.	0.0	170.7	0.0	209.4

HWY 36

	FLUORIDE	CHLORIDE	SULPHATE	CARBONATE	BICARBONATE	HYDROXIDE	TOTAL DISSOLVED SOLIDS
NOV	0.15	4.9	42.	0.0	170.7	0.0	206.8
DEC	0.12	7.3	53.	0.0	209.7	0.0	255.0
JAN	0.10	4.9	51.	0.0	182.9	0.0	226.9
FEB	0.10	4.9	51.	0.0	182.8	0.0	226.9
MAR	0.07	4.0	50.	0.0	152.4	0.0	198.5

OBJECTIVE 1.5

TABLE 7

OLDMAN RIVER
(All values in mg.L unless otherwise noted)

ABOVE LETHBRIDGE

	ARSENIC (diss)	BARIUM (total)	BORON (diss)	CADMIUM (total)	COBALT (total)	COPPER (total)	IRON (diss)	LEAD (total)
NOV	L.0005	-	0.03				L0.04	-
DEC	L.0005	-	0.07	-	-	-	L0.04	-
JAN	L.0005	0.12	0.04	L0.001	L0.002	L0.001	L0.04	L0.004
FEB	L.0005	-	0.02	-	-	-	L0.04	-
MAR	L.0005	-	0.06	-	-	-	L0.04	-

HWY 36

	ARSENIC (diss)	BARIUM (total)	BORON (diss)	CADMIUM (total)	COBALT (total)	COPPER (total)	IRON (diss)	LEAD (total)
NOV	L.0005	-	0.04	-	-	-	L0.04	-
DEC	L.0005	-	0.07	-	-	-	L0.04	-
JAN	L.0005	0.12	0.04	L0.001	L0.002	0.001	L0.01	-
FEB	L.0005	-	0.02	-	-	-	L0.04	-
MAR	L.0005	-	L0.02	-	-	-	L0.04	-

OBJECTIVE	0.01	1.0	0.5	0.01		0.02	0.3	0.05

TABLE 8

OLDMAN RIVER
(All values in mg.L unless otherwise noted)

ABOVE LETHBRIDGE

	MANGANESE (diss)	MERCURY (total-ug.L)	NICKEL (total)	SELENIUM (diss)	SILVER (extbl)	VANADIUM (total)	ZINC (total)
NOV	L0.01	L0.02	-	0.006	-	-	-
DEC	L0.01	L0.02	-	L0.0005	-	-	-
JAN	L0.01	L0.02	L0.002	0.0006	L0.004	L0.001	0.013
FEB	L0.01	L0.02	-	0.0007	-	-	-
MAR	L0.01	L0.02	-	0.0005	-	-	-

HWY 36

	MANGANESE (diss)	MERCURY (total-ug.L)	NICKEL (total)	SELENIUM (diss)	SILVER (extbl)	VANADIUM (total)	ZINC (total)
NOV	L0.01	L0.02	-	0.0005	-	-	-
DEC	L0.01	L0.02	-	0.0005	-	-	-
JAN	L0.01	L0.02	L0.002	0.0006	L0.004	L0.001	L0.001
FEB	L0.01	L0.02	-	0.0007	-	-	-
MAR	L0.01	L0.02	-	0.0005	-	-	-

OBJECTIVE	0.05	0.1		0.01	0.05		0.05

TABLE 9

OLDMAN RIVER
(all values in ug.L)

JAN	Above Lethbridge	Hwy 36 Taber		Above Lethbridge	Hwy 36 Taber
2,4-D	0.007	0.01	2,4-DB	L0.009	L0.009
ALDRIN	L0.001	L0.001	2,4,5-T	L0.002	L0.002
AROCLOR 1254	L0.002	L0.002	2,4-DP	L0.004	L0.004
AROCLOR TOTAL	L0.002	L0.002	AROCLOR 1242	L0.002	L0.002
ALPHA-CHLORDANE	L0.003	L0.003	AROCLOR 1260	L0.005	L0.005
P,P'-DDD	L0.002	L0.002	ALPHA-BHC	0.001	0.001
P,P'-DDT	L0.004	L0.004	GAMMA-CHLORDANE	L0.002	L0.002
DIELDRIN	L0.002	L0.002	P,P-'DDE	L0.001	L0.001
ETHYL GUTHION	L0.2	L0.2	O,P'-DDT	L0.001	L0.001
DISULFOTON	L0.2	L0.02	GUTHION	L0.5	L0.5
PARATHION	L0.02	L0.02	IMIDAN	L0.2	L0.2
MALATHION	L0.05	L0.05	RUELENE	L0.2	L0.2
DIAZINON	L0.02	L0.02	METHYL PARATHION	L0.02	L0.02
ETHION	L0.02	L0.02	RONNEL	L0.02	L0.02
ALPHA-ENDOSULFAN	L0.001	L0.001	PHORATE	L0.02	L0.02
ENDRIN	L0.002	L0.002	TRITHION	L0.02	L0.02
HEPTACHLOR EPOXIDE	L0.002	L0.002	BETA-ENDOSULFAN	L0.003	L0.003
MCPA	L0.2	L0.2	HEPTACHLOR	L0.001	L0.001
SILVEX	L0.004	L0.004	LINDANE	L0.001	L0.001
HCB	L0.001	L0.001	METHOXYCHLOR	L0.01	L0.01
MIREX	L0.001	L0.001			

SOUTH SASKATCHEWAN RIVER BASIN - BOW RIVER

Of the two monitoring sites, parameters met surface water quality objectives at Cochrane. Some parameters increased at the downstream station and exceeded objectives. Those parameters that exceeded objectives at the station near the mouth were phosphorus and nitrogen (Table 2). All phosphorus and nitrogen forms (Tables 2 & 3) were considerably higher downstream, as were particulate organic carbon and phenolic materials (Table 4), all of which are indicative of organic enrichment presumed to be caused by municipal discharges from Calgary.

The downstream station also showed higher concentrations of dissolved ions and total dissolved material, particularly potassium, calcium and sodium (Tables 5 & 6). These are considered to be natural changes in the river as it flows from the foothills to the prairies.

The March sample also reflected the earlier runoff at the mouth shown by the higher sediment loads (Residue N.F.) and turbidity. The particulate form of phosphorus increased as a result of runoff as well.

TABLE 1

BOW RIVER
(All values in mg/L unless otherwise noted)

AT COCHRANE

	OXYGEN	CONDUCTIVITY (us/cm)	PH (pH units)	TEMPERATURE (Deg C)	TURBIDITY (JTU)	COLOUR (Rel Units)	RESIDUE N.F.
NOV	12.3	297.	8.3	4.0	0.9	5.	L1.
DEC	10.5	309.	8.1	0.0	0.8	5.	L1.
JAN	12.7	327.	8.2	1.0	0.6	L5.	L1.
FEB	12.7	297.	8.2	0.0	0.4	5.	1.
MAR	13.0	293.	8.3	2.0	NV	L5.	L1.

NEAR MOUTH

	OXYGEN	CONDUCTIVITY (us/cm)	PH (pH units)	TEMPERATURE (Deg C)	TURBIDITY (JTU)	COLOUR (Rel Units)	RESIDUE N.F.
NOV	13.7	406.	8.3	2.0	NV	5.	3.
DEC	13.0	407.	7.9	0.0	5.0	L5.	7.
JAN	13.3	404.	8.1	0.5	7.0	L5.	13.
FEB	12.7	362.	NV	1.0	NV	10.	11.
MAR	12.8	343.	8.3	3.0	50.	20.	69.

OBJECTIVE	G5.0

TABLE 2

BOW RIVER
(all values in mg/L unless otherwise noted)

AT COCHRANE

	PHOSPHORUS (Total as P)	PHOSPHORUS (Total Soluble)	PHOSPHORUS (Particulate)	NITROGEN (Tot Ammonia as N)	NITROGEN (Diss as N)L
NOV	0.004	0.003	L0.006	L0.1	0.07
DEC	0.006	L0.003	L0.006	L0.1	0.02
JAN	0.008	L0.003	0.006	L0.1	0.10
FEB	0.005	0.004	L0.006	L0.1	0.10
MAR	0.007	L0.003	0.006	L0.1	0.08

NEAR MOUTH

	PHOSPHORUS (Total as P)	PHOSPHORUS (Total Soluble)	PHOSPHORUS (Particulate)	NITROGEN (Tot Ammonia as N)	NITROGEN (Diss as N)L
NOV	0.078	0.070	0.008	0.4	1.6
DEC	0.089	0.075	0.014	1.1	1.1
JAN	0.066	0.046	0.020	0.7	1.1
FEB	0.12	0.079	0.041	0.3	1.5
MAR	0.14	0.027	0.11	0.3	1.3

OBJECTIVE 0.05

TABLE 3

BOW RIVER
(All values in mg.L unless otherwise noted)

AT COCHRANE

	NITROGEN (Diss NO_3 + NO_2 as N)	NITROGEN (Total as N)	NITROGEN (Diss as N)F	NITROGEN (Part as N)L	CARBON (Diss Org as C)L
NOV	0.04	0.07	0.07	L0.01	1.6
DEC	0.07	0.11	0.08	0.02	0.7
JAN	0.10	0.11	0.10	L0.01	0.7
FEB	0.15	0.10	0.17	L0.01	0.8
MAR	0.05	0.08	0.08	L0.01	0.7

NEAR MOUTH

	NITROGEN (Diss NO_3 + NO_2 as N)	NITROGEN (Total as N)	NITROGEN (Diss as N)F	NITROGEN (Part as N)L	CARBON (Diss Org as C)
NOV	1.5	1.6	1.7	L0.01	1.9
DEC	0.90	1.1	1.2	L0.01	1.3
JAN	0.82	1.2	1.1	0.08	1.4
FEB	1.3	1.7	1.7	0.22	2.4
MAR	1.3	1.5	1.3	0.22	1.8

OBJECTIVE		1.0

TABLE 4

BOW RIVER
(All values in mg.L unless otherwise noted)

AT COCHRANE

	CARBON (Part Org as C)L	PHENOLICS	TOTAL COLIFORMS (no. 100 mL)	FECAL STREPTOCOCCUS (no. 100 mL)	FECAL COLIFORMS (no. 100 mL)
NOV	0.11	L0.001	4.	10.	L2.
DEC	0.19	L0.001	L2.	32.	L2.
JAN	0.11	L0.001	L2.	22.	1.
FEB	0.15	L0.001	2.	18.	L2.
MAR	0.18	0.003	4.	8.	L2.

NEAR MOUTH

	CARBON (Part Org as C)L	PHENOLICS	TOTAL COLIFORMS (no. 100 mL)	FECAL STREPTOCOCCUS (no. 100 mL)	FECAL COLIFORMS (no. 100 mL)
NOV	0.92	0.002	4.	23.	2.
DEC	0.36	0.001	6.	88.	5.
JAN	0.67	0.001	19.	108.	14.
FEB	1.2	0.003	G80.	G800.	20.
MAR	2.8	0.001	40.	470.	4.

OBJECTIVE		0.005	1000		200

TABLE 5

BOW RIVER
(All values in mg.L unless otherwise noted)

AT COCHRANE	ALKALINITY	HARDNESS (Total as $CaCO_3$)	MAGNESIUM	CALCIUM	POTASSIUM	SODIUM	SILICA (Reactive)
NOV	120.	152.1	12.8	39.8	0.4	1.5	3.1
DEC	125.	165.6	13.3	44.4	0.4	1.0	3.5
JAN	135.	177.9	13.6	48.8	0.4	1.7	3.4
FEB	125.	162.5	12.6	44.3	0.4	1.0	3.6
MAR	120.	161.6	12.5	44.1	0.4	1.2	3.4

NEAR MOUTH	ALKALINITY	HARDNESS (Total as $CaCO_3$)	MAGNESIUM	CALCIUM	POTASSIUM	SODIUM	SILICA (Reactive)
NOV	150.	202.4	17.5	52.2	1.6	12.	0.7
DEC	157.	204.8	16.8	54.3	1.3	8.1	3.0
JAN	145.	194.5	15.7	52.0	1.2	8.5	3.6
FEB	135.	179.4	14.4	48.1	2.0	7.7	3.0
MAR	120.	156.4	12.5	42.0	1.7	12.	2.2

OBJECTIVE	1.5

TABLE 6

BOW RIVER
(All values in mg.L unless otherwise noted)

AT COCHRANE	FLUORIDE	CHLORIDE	SULPHATE	CARBONATE	BICARBONATE	HYDROXIDE	TOTAL DISSOLVED SOLIDS
NOV	0.16	1.0	31.	0.0	146.3	0.0	161.9
DEC	0.12	1.2	36.	0.0	152.4	0.0	175.2
JAN	0.14	1.2	38.	0.0	164.6	0.0	188.7
FEB	0.10	1.0	38.	0.0	152.4	0.0	176.7
MAR	0.08	0.9	40.	0.0	146.3	0.0	174.8

NEAR MOUTH	FLUORIDE	CHLORIDE	SULPHATE	CARBONATE	BICARBONATE	HYDROXIDE	TOTAL DISSOLVED SOLIDS
NOV	0.21	6.8	53.	0.0	182.8	0.0	240.7
DEC	0.14	6.2	50.	0.0	191.0	0.0	231.3
JAN	0.13	6.5	53.	0.0	176.8	0.0	231.3
FEB	0.13	5.7	50.	0.0	164.6	0.0	217.8
MAR	0.07	7.4	48.	0.0	146.3	0.0	203.6

OBJECTIVE	1.5

TABLE 7

BOW RIVER

AT COCHRANE	ARSENIC (diss)	BARIUM (total)	BORON (diss)	CADMIUM (total)	COBALT (total)	COPPER (total)	IRON (diss)	LEAD (total)
NOV	L.0005	-	0.03	-	-	-	L0.04	-
DEC	L.0005	-	0.05	-	-	-	L0.04	-
JAN	L.0005	L0.05	0.04	L0.001	L0.002	L0.001	L0.04	L0.004
FEB	L.0005	-	0.02	-	-	-	L0.04	-
MAR	L.0005	-	L0.02	-	-	-	L0.04	-

AT MOUTH	ARSENIC (diss)	BARIUM (total)	BORON (diss)	CADMIUM (total)	COBALT (total)	COPPER (total)	IRON (diss)	LEAD (total)
NOV	L.0005	-	0.06	-	-	-	L0.04	-
DEC	L.0005	-	0.11	-	-	-	L0.04	-
JAN	L.0005	L0.05	0.07	L0.001	L0.002	0.002	L0.04	L0.004
FEB	L.0005	-	0.07	-	-	-	L0.04	-
MAR	L.0005	-	0.05	-	-	-	L0.04	-

OBJECTIVE	0.01	1.0	0.5	0.1		0.02	0.3	0.05

TABLE 9

BOW RIVER
(all values in ug.L)

JAN	At Cochrane	Near Mouth		At Cochrane	Near Mouth
2,4-D	L0.004	0.009	2,4-DB	L0.009	L0.009
ALDRIN	L0.001	L0.001	2,4,5-T	L0.002	L0.002
AROCLOR 1254	L0.002	L0.002	2,4-DP	L0.004	L0.004
AROCLOR TOTAL	L0.002	L0.002	AROCLOR 1242	L0.002	L0.002
ALPHA-CHLORDANE	L0.003	L0.003	AROCLOR 1260	L0.005	L0.005
P,P'-DDD	L0.002	L0.002	ALPHA-BHC	L0.001	L0.001
P,P'-DDT	L0.004	L0.004	GAMMA-CHLORDANE	L0.002	L0.002
DIELDRIN	L0.002	L0.002	P,P-'DDE	L0.001	L0.001
ETHYL GUTHION	L0.2	L0.2	O,P'-DDT	L0.001	L0.001
DISULFOTON	L0.02	L0.02	GUTHION	L0.5	L0.5
PARATHION	L0.02	L0.02	IMIDAN	L0.2	L0.2
MALATHION	L0.05	L0.05	RUELENE	L0.2	L0.2
DIAZINON	L0.02	L0.02	METHYL PARATHION	L0.02	L0.02
ETHION	L0.02	L0.02	RONNEL	L0.02	L0.02
ALPHA-ENDOSULFAN	L0.001	L0.001	PHORATE	L0.02	L0.02
ENDRIN	L0.002	L0.002	TRITHION	L0.02	L0.02
HEPTACHLOR EPOXIDE	L0.002	L0.002	BETA-ENDOSULFAN	L0.003	L0.003
MCPA	L0.2	L0.2	HEPTACHLOR	L0.001	L0.001
SILVEX	L0.004	L0.004	LINDANE	L0.001	L0.001
HCB	L0.001	L0.001	METHOXYCHLOR	L0.01	L0.01
MIREX	L0.001				

SOUTH SASKATCHEWAN RIVER BASIN - SOUTH SASKATCHEWAN RIVER

This location is monitored under the auspices of the Prairie Provinces Water Board as part of the interprovincial water agreements. The nutrients, phosphorus and nitrogen (Tables 2 & 3), are the only parameters which exceeded objective concentrations. This is primarily a reflection of anthropogenic inputs from the Bow and Oldman Rivers, although the large drainage area and diffuse sources could also have contributed to the loading.

TABLE 1

SOUTH SASK RIVER
(All values in mg/L unless otherwise noted)

AT HWY 41

	OXYGEN	CONDUCTIVITY (us/cm)	PH (pH units)	TEMPERATURE (Deg C)	TURBIDITY (JTU)	COLOUR (Ret Units)	RESIDUE N.F.
NOV	13.3	378.	8.3	0.0	19.0	10.	30.
DEC	13.8	464.	8.1	0.0	2.9	5.	5.
JAN	13.1	413.	7.9	0.0	5.6	L5.	9.
FEB	11.8	372.	7.9	0.4	9.8	20.	19.
MAR	13.7	358.	8.4	0.5	17.0	20.	41.
OBJECTIVE	G5.0						

TABLE 2

SOUTH SASK RIVER
(All values in mg.L unless otherwise noted)

AT HWY 41

	PHOSPHORUS (Total as P)	PHOSPHORUS (Total Soluble)	PHOSPHORUS (Particulate)	NITROGEN (Tot Ammonia as N)	NITROGEN (Diss as N)L
NOV	0.068	0.020	0.048	L0.1	0.15
DEC	0.049	0.036	0.013	L0.1	1.3
JAN	0.065	0.053	0.012	0.5	1.0
FEB	0.10	0.067	0.033	0.3	1.3
MAR	0.11	0.010	0.10	L0.1	0.91
OBJECTIVE	0.05				

TABLE 3

SOUTH SASK RIVER
(All values in mg.L unless otherwise noted)

AT HWY 41

	NITROGEN (Diss NO_3 + NO_2 as N)	NITROGEN (Total as N)	NITROGEN (Diss as N)F	NITROGEN (Part as N)L	CARBON (Diss Org as C)L
NOV	0.74	1.1	0.85	0.15	1.9
DEC	0.90	1.3	1.3	0.05	1.5
JAN	0.82	1.1	1.0	0.06	1.9
FEB	1.2	1.4	1.3	0.12	2.8
MAR	0.90	1.1	0.91	0.16	1.6
OBJECTIVE		1.0			

TABLE 4

SOUTH SASK RIVER
(All values in mg.L unless otherwise noted)

AT HWY 41

	CARBON (Part Org as C)	PHENOLICS	TOTAL COLIFORMS (no. 100 mL)	FECAL STREPTOCOCCUS (no. 100 mL)	FECAL COLIFORMS (no. 100 mL)
NOV	1.3	L0.001	200.	-	2.
DEC	0.31	L0.001	550.	-	62.
JAN	0.37	0.001	260.	-	20.
FEB	0.86	0.003	520.	-	2.
MAR	1.4	L0.001	NV	-	190.
OBJECTIVE		0.005	1000.		200.

TABLE 5

SOUTH SASK RIVER
(All values in mg.L unless otherwise noted)

AT HWY 41	ALKALINITY	HARDNESS (Total as $CaCO_3$)	MAGNESIUM	CALCIUM	POTASSIUM	SODIUM	SILICA (Reactive)
NOV	135.	155.8	14.3	38.8	1.5	13.	0.5
DEC	165.	211.9	18.4	54.5	1.6	14.	2.1
JAN	150.	190.9	16.1	49.9	1.5	12.0	2.5
FEB	130.	171.0	14.3	14.9	2.6	14.	1.6
MAR	120.	150.5	12.9	39.0	1.4	17.	L0.1
OBJECTIVE	1.5						

TABLE 6

SOUTH SASK RIVER
(All values in mg.L unless otherwise noted)

AT HWY 41

	FLUORIDE	CHLORIDE	SULPHATE	CARBONATE	BICARBONATE	HYDROXIDE	TOTAL DISSOLVED SOLIDS
NOV	0.18	5.3	50.	0.0	164.6	0.0	207.9
DEC	0.13	7.7	59.	0.0	201.1	0.0	260.4
JAN	0.13	5.9	55.	0.0	182.8	0.0	236.7
FEB	0.15	6.4	54.	0.0	158.5	0.0	221.3
MAR	0.07	10.	52.	0.5	145.8	0.0	208.1
OBJECTIVE	1.5						

TABLE 7

SOUTH SASK RIVER
(All values in mg.L unless otherwise noted)

AT HWY 41	ARSENIC (diss)	BARIUM (total)	BORON (diss)	CADMIUM (total)	COBALT (total)	COPPER (total)	IRON (diss)	LEAD (total)
NOV	L.0005	0.07	0.04	L0.001	L0.002	0.001	L0.04	L0.004
DEC	L.0005	0.07	0.08	L0.001	L0.002	0.001	L0.04	L0.004
JAN	L.0005	0.05	0.08	L0.001	L0.002	L0.001	L0.04	L0.004
FEB	0.0005	0.07	0.06	L0.001	L0.002	0.003	L0.04	L0.004
MAR	L.0005	0.05	0.09	L0.001	L0.002	0.002	L0.04	L0.004
OBJECTIVE	0.01	1.0	0.5	0.1		0.02	0.3	0.05

TABLE 8

SOUTH SASK RIVER
(All values in mg.L unless otherwise noted)

AT HWY 41	MANGANESE (diss)	MERCURY (total-(ug.L)	NICKEL (total)	SELENIUM (diss)	SILVER (extbl)	VANADIUM (total)	ZINC (total)
NOV	L0.01	L0.02	L0.002	L.0005	-	0.001	0.005
DEC	L0.01	L0.02	L0.002	L.0005	-	L0.001	0.003
JAN	L0.01	0.02	0.002	L.0005	-	L0.001	0.007
FEB	L0.01	L0.02	L0.002	L.0005	-	L0.001	0.005
MAR	L0.01	L0.02	L0.002	L.0005	-	0.001	NV
OBJECTIVE	0.05	0.1		0.01	0.05		0.05

TABLE 9

SOUTH SASK RIVER
(all values in ug.L)

AT HWY 41	NOV	DEC	JAN	FEB	MAR
2,4-D	0.05	0.1	0.03	0.01	0.02
ALDRIN	L0.001	L0.001	L0.001	L0.001	L0.001
AROCLOR 1254	L0.002	L0.002	L0.002	L0.002	L0.002
AROCLOR TOTAL	L0.002	L0.002	L0.002	L0.002	L0.002
ALPHA-CHLORDANE	L0.003	L0.003	L0.003	L0.003	L0.003
P,P'-DDD	L0.002	L0.002	L0.002	L0.002	L0.002
P,P'-DDT	L0.004	L0.004	L0.004	L0.004	L0.004
DIELDRIN	L0.002	L0.002	L0.002	L0.002	L0.002
ETHYL GUTHION	-	-	-	-	-
DISULFOTON	-	-	-	-	-
PARATHION	-	-	-	-	-
MALATHION	-	-	-	-	-
DIAZINON	-	-	-	-	-
ETHION	-	-	-	-	-
ALPHA-ENDOSULFAN	L0.001	L0.001	L0.001	L0.001	L0.001
ENDRIN	L0.002	L0.002	L0.002	L0.002	L0.002
HEPTACHLOR EPOXIDE	L0.002	L0.002	L0.002	L0.002	L0.002
MCPA	L0.2	L0.2	L0.2	L0.2	L0.2
SILVEX	L0.004	L0.004	L0.004	L0.004	L0.004
HCB	L0.001	L0.001	L0.001	L0.001	L0.001
MIREX	L0.001	L0.001	L0.001	L0.001	L0.001

The river at Highway 2 above Red Deer met objectives for all parameters. Below Red Deer, both at Drumheller and Bindloss (PPWB station), phosphorus and nitrogen (Tables 2 & 3) exceeded objective concentrations; fecal coliforms (Table 4) also exceeded objectives at Drumheller in March. All other parameters met objectives at these stations.

The main change in water quality in the Red Deer river was one of enrichment. This was particularly noticeable in the total soluble phosphorus and dissolved nitrogen levels (Table 2) at Drumheller and Bindloss. Dissolved organic carbon (Table 3) also increased downstream.

Low winter dissolved oxygen is a noticeable seasonal trend in the Red Deer River which is most evident in January when values were 5.0 mg.L at Drumheller (Table 1). This is an annual phenomenon in the lower Red Deer River and values sometimes go to zero. This is thought to be due to both natural and anthropogenic inputs and a consequently high biological demand for oxygen to process the materials.

It is also of note that one high fecal coliform count (Table 4) was observed at Drumheller in March. This is thought to relate to the discharge of raw sewage which occurred in that month. Subsequent sampling showed no obvious sign of contamination. It is suspected, therefore, that the value shown was taken during the latter part of the spill.

TABLE 1

RED DEER RIVER
(All values in mg/L unless otherwise noted)

NEAR BINDLOSS

	OXYGEN	CONDUCTIVITY (us/cm)	PH (pH units)	TEMPERATURE (Deg C)	TURBIDITY (JTU)	COLOUR (Rct Units)	RESIDUE N.F.
NOV	13.7	565.	8.4	0.0	7.0	10.	18.
DEC	6.8	812.	8.0	0.0	1.2	10.	L1.
JAN	6.4	686.	7.7	0.0	2.2	10.	2.
FEB	10.2	592.	7.7	1.0	13.5	50.	35.
MAR	12.7	442.	8.1	0.5	G1000.	60.	528.
OBJECTIVE	G5.0						

TABLE 2

RED DEER RIVER
(All values in mg.L unless otherwise noted)

NEAR BINDLOSS

	PHOSPHORUS (Total as P)	PHOSPHORUS (Total Soluble)	PHOSPHORUS (Particulate)	NITROGEN (Tot Ammonia as N)	NITROGEN (Diss as N)L
NOV	0.025	0.007	0.018	L0.1	0.25
DEC	0.011	0.005	0.006	L0.1	0.41
JAN	0.012	0.006	0.006	L0.1	0.66
FEB	0.11	0.059	0.051	0.1	1.0
MAR	0.34	0.025	0.31	L0.1	0.56
OBJECTIVE	0.05				

TABLE 3

RED DEER RIVER
(All values in mg.L unless otherwise noted)

NEAR BINDLOSS

	NITROGEN (Diss NO_3 + NO_2 as N)	NITROGEN (Total as N)	NITROGEN (Diss as N)F	NITROGEN (Part as N)L	CARBON (Diss Org as C)L
NOV	0.03	0.32	0.22	0.07	4.8
DEC	0.02	NV	0.41	NV	6.2
JAN	0.48	0.70	0.67	0.04	3.6
FEB	0.64	1.2	1.0	0.23	6.1
MAR	0.27	1.8	0.65	1.2	5.8
MEAN					
OBJECTIVE		1.0			

TABLE 4

RED DEER RIVER
(All values in mg.L unless otherwise noted)

NEAR BINDLOSS

	CARBON (Part Org as C)	PHENOLICS	TOTAL COLIFORMS (no. 100 mL)	FECAL STREPTOCOCCUS (no. 100 mL)	FECAL COLIFORMS (no. 100 mL)
NOV	0.59	0.001	10.	-	2.
DEC	NV	L0.001	2.	-	L2.
JAN	0.32	0.001	93.	-	L1.
FEB	1.4	0.008	20.	-	4.
MAR	7.5	0.005	L100.	-	40.
OBJECTIVE		0.006	100		200

TABLE 5

RED DEER RIVER
(All values in mg.L unless otherwise noted)

NEAR BINDLOSS	ALKALINITY	HARDNESS (Total as $CaCO_3$)	MAGNESIUM	CALCIUM	POTASSIUM	SODIUM	SILICA (Reactive)
NOV	220.	218.1	20.7	53.2	2.2	30.	1.8
DEC	335.	330.5	34.9	74.8	3.2	38.	4.3
JAN	290.	300.9	27.7	74.8	2.4	30.	6.2
FEB	195.	228.6	21.0	56.9	5.8	36.	4.8
MAR	120.	139.1	12.5	35.1	3.5	42.	3.8
OBJECTIVE	1.5						

TABLE 6

RED DEER RIVER
(All values in mg.L unless otherwise noted)

NEAR BINDLOSS

	FLUORIDE	CHLORIDE	SULPHATE	CARBONATE	BICARBONATE	HYDROXIDE	TOTAL DISSOLVED SOLIDS
NOV	0.20	6.3	75.	0.0	268.2	0.0	321.5
DEC	0.17	9.4	87.	0.0	432.7	0.0	464.9
JAN	0.13	6.5	74.	0.0	353.5	0.0	397.9
FEB	0.16	6.7	108.	0.0	237.7	0.0	359.2
MAR	0.06	5.5	98.	0.0	146.8	0.0	273.7
OBJECTIVE	1.5						

TABLE 7

RED DEER RIVER
(All values in mg.L unless otherwise noted)

NEAR BINDLOSS	ARSENIC (diss)	BARIUM (total)	BORON (diss)	CADMIUM (total)	COBALT (total)	COPPER (total)	IRON (diss)	LEAD (total)
NOV	L.0005	0.09	0.04	L0.001	L0.002	0.001	L0.04	L0.004
DEC	L.0005	0.16	0.12	L0.001	L0.002	0.001	L0.04	L0.004
JAN	L.0005	0.15	0.09	L0.001	L0.002	L0.001	L0.04	L0.004
FEB	0.0005	0.12	0.10	L0.001	L0.002	0.004	L0.04	L0.004
MAR	L.0005	0.18	0.04	L0.001	0.005	0.013	0.15	0.006
OBJECTIVE	0.01	1.0	0.5	0.1		0.02	0.3	0.05

TABLE 8

RED DEER RIVER
(All values in mg.L unless otherwise noted)

NEAR BINDLOSS	MANGANESE (diss)	MERCURY (total-(ug.L)	NICKEL (total)	SELENIUM (diss)	SILVER (extbl)	VANADIUM (total)	ZINC (total)
NOV	L0.01	L0.02	L0.002	L.0005	-	L0.001	0.003
DEC	0.02	L0.02	0.002	L.0005	-	L0.001	0.004
JAN	L0.01	L0.02	L0.002	L.0005	-	L0.001	L0.001
FEB	L0.01	L0.02	L0.002	L.0005	-	0.002	0.010
MAR	0.01	0.06	0.007	L.0005	-	0.023	NV
OBJECTIVE	0.05	0.01		0.01	0.05		0.05

TABLE 1

RED DEER RIVER
(All values in mg/L unless otherwise noted)

HWY 2 - ABOVE RED DEER

	OXYGEN	CONDUCTIVITY (us/cm)	PH (pH units)	TEMPERATURE (Deg C)	TURBIDITY (JTU)	COLOUR (Rel Units)	RESIDUE N.F.
NOV	13.0	430.	8.5	2.0	1.5	10.	L1.
DEC	11.6	507.	7.7	0.0	1.6	10.	L1.
JAN	10.6	506.	7.7	0.0	1.1	5.	2.
FEB	10.9	512.	7.7	0.5	2.0	2.	2.
MAR	11.0	459.	8.0	0.5	1.6	L5.	2.

AT DRUMHELLER

	OXYGEN	CONDUCTIVITY (us/cm)	PH (pH units)	TEMPERATURE (Deg C)	TURBIDITY (JTU)	COLOUR (Rel Units)	RESIDUE N.F.
NOV	12.9	400.	8.6	0.0	1.0	20.	6.
DEC	7.9	590.	7.7	0.0	0.8	10.	2.
JAN	5.0	591.	7.6	0.0	0.8	5.	1.
FEB	8.8	531.	7.9	0.0	3.0	10.	5.
MAR	11.6	611.	8.3	1.5	450.	50.	308.

OBJECTIVE G5.0

TABLE 2

RED DEER RIVER
(All values in mg.L unless otherwise noted)

HWY 2 - ABOVE RED DEER

	PHOSPHORUS (Total as P)	PHOSPHORUS (Total Soluble)	PHOSPHORUS (Particulate)	NITROGEN (Tot Ammonia as N)	NITROGEN (Diss as N)L
NOV	0.052	0.006	0.046	L0.1	L0.01
DEC	0.018	0.008	NV	L0.1	0.21
JAN	0.003	L0.003	L0.006	L0.1	0.26
FEB	0.010	0.003	0.007	L0.1	L0.01
MAR	0.007	L0.003	0.006	L0.1	0.28

AT DRUMHELLER

	PHOSPHORUS (Total as P)	PHOSPHORUS (Total Soluble)	PHOSPHORUS (Particulate)	NITROGEN (Tot Ammonia as N)	NITROGEN (Diss as N)L
NOV	0.013	0.005	0.008	L0.1	0.20
DEC	0.031	0.027	L0.006	0.1	0.59
JAN	0.064	0.060	L0.006	0.2	0.77
FEB	0.048	0.040	0.008	L0.1	0.65
MAR	0.36	0.15	0.21	L0.1	1.3

OBJECTIVE 0.05

TABLE 3

RED DEER RIVER
(All values in mg.L unless otherwise noted)

HWY 2 - ABOVE RED DEER

	NITROGEN (Diss NO_3 + NO_2 as N)	NITROGEN (Total as N)	NITROGEN (Diss as N)F	NITROGEN (Part as N)L	CARBON (Diss Org as C)L
NOV	L0.01	0.12	0.13	L0.01	3.6
DEC	0.13	0.21	0.21	L0.01	2.4
JAN	0.17	0.26	0.26	L0.01	2.2
FEB	0.20	0.31	0.27	L0.01	4.1
MAR	0.21	0.28	0.28	L0.01	2.9

AT DRUMHELLER

	NITROGEN (Diss NO_3 + NO_2 as N)	NITROGEN (Total as N)	NITROGEN (Diss as N)F	NITROGEN (Part as N)L	CARBON (Diss Org as C)
NOV	L0.01	0.20	0.20	L0.01	4.8
DEC	0.40	0.59	0.60	L0.01	3.4
JAN	0.54	0.77	0.77	L0.01	3.1
FEB	0.56	0.70	0.61	0.05	2.7
MAR	0.85	2.1	1.1	0.76	8.0

OBJECTIVE	1.0

TABLE 4

RED DEER RIVER
(All values in mg.L unless otherwise noted)

HWY 2 - ABOVE RED DEER

	CARBON (Part Org as C)L	PHENOLICS	TOTAL COLIFORMS (no. 100 mL)	FECAL STREPTOCOCCUS (no. 100 mL)	FECAL COLIFORMS (no. 100 mL)
NOV	0.12	L0.001	15.	140.	L2.
DEC	0.17	0.005	16.	530.	L2.
JAN	0.14	L0.001	46.	420.	8.
FEB	0.18	0.003	119.	125.	6.
MAR	0.17	0.004	47.	43.	2.

AT DRUMHELLER

	CARBON (Part Org as C)L	PHENOLICS	TOTAL COLIFORMS (no. 100 mL)	FECAL STREPTOCOCCUS (no. 100 mL)	FECAL COLIFORMS (no. 100 mL)
NOV	0.33	0.002	10.	22.	2.
DEC	0.08	L0.001	20.	18.	L2.
JAN	0.11	0.001	97.	G120.	28.
FEB	0.31	0.001	810.	110.	58.
MAR	5.2	0.007	NV	27000.	400.

OBJECTIVE		0.005	1000		200

TABLE 5

RED DEER RIVER
(All values in mg.L unless otherwise noted)

HWY 2 - ABOVE RED DEER	ALKALINITY	HARDNESS (Total as $CaCO_3$)	MAGNESIUM	CALCIUM	POTASSIUM	SODIUM	SILICA (Reactive)
NOV	197.	203.1	17.0	53.3	1.3	8.7	4.5
DEC	230.	236.0	21.4	59.2	1.3	10.	6.9
JAN	230.	257.4	21.7	67.3	1.4	10.	7.0
FEB	220.	245.3	21.0	63.6	1.2	9.7	7.2
MAR	220.	251.3	21.0	66.0	1.3	9.3	7.0

AT DRUMHELLER	ALKALINITY	HARDNESS (Total as $CaCO_3$)	MAGNESIUM	CALCIUM	POTASSIUM	SODIUM	SILICA (Reactive)
NOV	220.	213.3	18.8	54.4	1.9	18.	2.0
DEC	260.	259.0	23.6	64.8	2.0	16.	6.7
JAN	255.	284.0	23.6	74.8	2.0	18.	7.4
FEB	240.	265.0	22.4	69.2	1.7	17.	5.6
MAR	210.	185.1	17.6	45.1	6.5	65.	6.6

OBJECTIVE	1.5

TABLE 6

RED DEER RIVER
(All values in mg.L unless otherwise noted)

HWY 2 - ABOVE RED DEER

	FLUORIDE	CHLORIDE	SULPHATE	CARBONATE	BICARBONATE	HYDROXIDE	TOTAL DISSOLVED SOLIDS
NOV	0.16	3.0	39.	0.0	240.1	0.0	245.2
DEC	0.16	1.8	41.	0.0	280.4	0.0	280.3
JAN	0.13	1.6	45.	0.0	280.4	0.0	292.9
FEB	0.11	1.4	46.	0.0	268.2	0.0	283.1
MAR	0.18	1.5	44.	0.0	268.2	0.0	283.2

AT DRUMHELLER

	FLUORIDE	CHLORIDE	SULPHATE	CARBONATE	BICARBONATE	HYDROXIDE	TOTAL DISSOLVED SOLIDS
NOV	0.15	3.7	43.	0.0	268.2	0.0	274.0
DEC	0.14	3.6	49.	0.0	316.9	0.0	323.6
JAN	0.17	4.9	54.	0.0	310.8	0.0	340.3
FEB	0.17	3.7	50.	0.0	292.6	0.0	316.3
MAR	0.12	5.9	110.	0.0	256.0	0.0	386.6

OBJECTIVE 1.5

TABLE 7

RED DEER RIVER
(All values in mg.L unless otherwise noted)

HWY 2 - ABOVE RED DEER

	ARSENIC (diss)	BARIUM (total)	BORON (diss)	CADMIUM (total)	COBALT (total)	COPPER (total)	IRON (diss)	LEAD (total)
NOV	L.0005	-	0.05	-	-	-	0.05	-
DEC	L.0005	-	0.05	-	-	-	L0.04	-
JAN	L.0005	0.11	0.07	L0.001	L0.002	L0.001	L0.04	L0.004
FEB	L.0005	-	0.05	-	-	-	L0.04	-
MAR	L.0005	-	0.03	-	-	-	L0.04	-

AT DRUMHELLER

	ARSENIC (diss)	BARIUM (total)	BORON (diss)	CADMIUM (total)	COBALT (total)	COPPER (total)	IRON (diss)	LEAD (total)
NOV	L.0005	-	0.06	-	-	-	L0.04	-
DEC	L.0005	-	0.11	-	-	-	L0.04	-
JAN	L.0005	0.12	0.09	L0.001	L0.002	0.001	L0.04	-
FEB	L.0005	-	0.06	-	-	-	L0.04	-
MAR	0.0007	-	0.10	-	-	-	0.08	-

OBJECTIVE	0.01	1.0	0.5	0.1		0.02	0.3	0.05

TABLE 8

RED DEER RIVER

HWY 2 - ABOVE RED DEER

	MANGANESE (diss)	MERCURY (total-(ug.L)	NICKEL (total)	SELENIUM (diss)	SILVER (extbl)	VANADIUM (total)	ZINC (total)
NOV	L0.01	L0.02	-	L.0005	-	-	-
DEC	L0.01	L0.02	-	L.0005	-	-	-
JAN	L0.01	L0.02	0.002	L.0005	L0.004	L0.001	0.001
FEB	L0.01	L0.02	-	0.0005	-	-	-
MAR	L0.01	L0.02	-	0.0005	-	-	-

AT DRUMHELLER

	MANGANESE (diss)	MERCURY total-(ug.L)	NICKEL (total)	SELENIUM (diss)	SILVER (extbl)	VANADIUM (total)	ZINC (total)
NOV	L0.01	L0.02	-	L.0005	-	-	-
DEC	L0.01	L0.02	-	L.0005	-	-	-
JAN	L0.01	L0.02	-	L.0005	-	-	-
FEB	L0.01	L0.02	-	0.0005	-	-	-
MAR	0.05	0.06	-	L.0005	-	-	-
OBJECTIVE	0.5	0.01		0.01	0.05		0.05

TABLE 9

RED DEER RIVER
(all values in ug.L)

JAN	Hwy 2 - above Red Deer	At Drumheller		Hwy 2 - above Red Deer	At Drumheller
2,4-D	L0.004	L0.004	2,4-DB	L0.009	L0.009
ALDRIN	L0.001	L0.001	2,4,5-T	L0.002	L0.002
AROCLOR 1254	L0.002	L0.002	2,4-DP	L0.004	L0.004
AROCLOR TOTAL	L0.002	L0.002	AROCLOR 1242	L0.002	L0.002
ALPHA-CHLORDANE	L0.003	L0.003	AROCLOR 1260	L0.005	L0.005
P,P'-DDD	L0.002	L0.002	ALPHA BHC	L0.001	L0.001
P,P'-DDT	L0.004	L0.004	GAMMA CHLORDANE	L0.002	L0.002
DIELDRIN	L0.002	L0.002	P,P-'DE	L0.001	L0.001
ETHYL GUTHION	L0.2	L0.2	O,P'-DDT	L0.001	L0.001
DISULFOTON	L0.02	L0.02	GUTHION	L0.5	L0.5
PARATHION	L0.02	L0.02	IMIDAN	L0.2	L0.2
MALATHION	L0.05	L0.05	RUELENE	L0.2	L0.2
DIAZINON	L0.02	L0.02	METHYL PARATHION	L0.02	L0.02
ETHION	L0.02	L0.02	RONNEL	L0.02	L0.02
ALPHA-ENDOSULFAN	L0.001	L0.001	PHORATE	L0.02	L0.02
ENDRIN	L0.002	L0.002	TRITHION	L0.02	L0.02
HEPTACHLOR EPOXIDE	L0.002	L0.002	BETA-ENDOSULFAN	L0.003	L0.003
MCPA	L0.2	L0.2	HEPTACHLOR	L0.001	L0.001
SILVEX	L0.004	L0.004	LINDANE	L0.001	L0.001
HCB	L0.001	L0.001	METHOXYCHLOR	L0.01	L0.01
MIREX	L0.001	L0.001			

NORTH SASKATCHEWAN RIVER BASIN - BATTLE RIVER

The Battle River is monitored on a routine monthly basis at the border with Saskatchewan near Unwin. This river, unlike the South Saskatchewan Basin systems, is not fed primarily by mountain snowmelt but rather by parkland and prairie surface runoff starting from its source, Battle Lake. The water quality of the river reflects this: it can have a much higher colour (Table 1), almost 5 times higher than the South Saskatchewan or North Saskatchewan at the border, and also much greater dissolved organic carbon (Table 3), 10-15 mg.L (cf 1.4 - 3.6 mg.L NSR at Lea Park). The different water quality reflects the nature of the drainage area and probably the intensive agricultural activity in the watershed. The high levels of phosphorus and nitrogen also probably originate from diffuse agricultural runoff sources rather than from municipal effluent, which in the most part discharges from sewage lagoons either in spring or fall, or both.

The parameters which failed to meet objectives were dissolved oxygen in January and February, which reflected the high organic load and consequent oxygen demand under ice when no re-aeration occurs, and phosphorus in November and December. The phosphorus was primarily in the particulate form which again reflected diffuse runoff as a major contributor. Nitrogen exceeded the objectives on occasions.

TABLE 1

BATTLE RIVER
(All values in mg.L unless otherwise noted)

NEAR UNWIN

	OXYGEN	CONDUCTIVITY (us/cm)	PH (pH units)	TEMPERATURE (Deg C)	TURBIDITY (JTU)	COLOUR (Ret Units)	RESIDUE N.F.
NOV	13.6	763.	8.4	0.0	8.6	50.	15.
DEC	8.3	819.	7.8	0.0	7.8	30.	10.
JAN	3.6	906.	7.6	0.0	5.9	30.	3.
FEB	3.7	859.	7.4	0.0	4.4	30.	19.
MAR	6.2	922.	7.4	0.2	8.0	40.	5.
OBJECTIVE	G5.0						

TABLE 2

BATTLE RIVER
(All values in mg.L unless otherwise noted)

NEAR UNWIN

	PHOSPHORUS (Total as P)	PHOSPHORUS (Total Soluble)	PHOSPHORUS (Particulate)	NITROGEN (Tot Ammonia as N)	NITROGEN (Diss as N)L
NOV	0.074	0.023	0.051	LO.1	0.67
DEC	0.063	0.017	0.046	LO.1	0.68
JAN	0.047	0.015	0.032	0.4	0.52
FEB	0.042	0.014	0.028	0.2	0.97
MAR	0.043	0.019	0.024	0.1	0.90
OBJECTIVE	0.05				

TABLE 3

BATTLE RIVER
(All values in mg.L unless otherwise noted)

NEAR UNWIN

	NITROGEN (Diss NO_3 + NO_2 as N)	NITROGEN (Total as N)	NITROGEN (Diss as N)F	NITROGEN (Part as N)L	CARBON (Diss Org as C)L
NOV	L0.01	0.87	0.70	0.20	15.
DEC	0.04	0.91	0.70	0.23	16.
JAN	0.20	0.59	0.55	0.07	12.
FEB	0.45	1.1	0.97	0.08	12.
MAR	0.45	1.0	0.89	0.10	10.
OBJECTIVE		1.0			

TABLE 4

BATTLE RIVER
(All values in mg.L unless otherwise noted)

NEAR UNWIN

	CARBON (Part Org as C)	PHENOLICS	TOTAL COLIFORMS (no. 100 mL)	FECAL STREPTOCOCCUS (no. 100 mL)	FECAL COLIFORMS (no. 100 mL)
NOV	1.3	0.004	10.	-	8.
DEC	1.5	0.003	2.	-	2.
JAN	0.45	0.002	6.	-	2.
FEB	0.51	0.003	2.	-	L2.
MAR	0.80	0.003	12.	-	2.
OBJECTIVE		0.005	1000		200

TABLE 5

BATTLE RIVER
(All values in mg.L unless otherwise noted)

NEAR UNWIN	ALKALINITY	HARDNESS (Total as $CaCO_3$)	MAGNESIUM	CALCIUM	POTASSIUM	SODIUM	SILICA (Reactive)
NOV	310.	238.0	23.3	56.9	8.6	80.	7.5
DEC	325.	261.0	26.7	60.5	7.6	79.	6.4
JAN	375.	313.8	30.0	76.2	8.1	90.	9.4
FEB	380.	307.9	29.9	74.0	7.7	95.	11.
MAR	379.	304.2	29.9	72.5	7.3	100.	11.
OBJECTIVE	1.5						

TABLE 6

BATTLE RIVER
(All values in mg.L unless otherwise noted)

NEAR UNWIN

	FLUORIDE	CHLORIDE	SULPHATE	CARBONATE	BICARBONATE	HYDROXIDE	TOTAL DISSOLVED SOLIDS
NOV	0.24	10.	94.	0.0	377.9	0.0	466.5
DEC	0.19	12.	95.	0.0	396.2	0.0	482.6
JAN	0.16	16.	102.	0.0	457.1	0.0	557.7
FEB	0.20	17.	108.	0.0	463.2	0.0	572.8
MAR	0.11	17.	126.	0.0	462.0	0.0	593.2
OBJECTIVE	1.5						

TABLE 7

BATTLE RIVER
(All values in mg.L unless otherwise noted)

NEAR UNWIN	ARSENIC (diss)	BARIUM (total)	BORON (diss)	CADMIUM (total)	COBALT (total)	COPPER (total)	IRON (diss)	LEAD (total)
NOV	0.0010	0.11	0.15	L0.001	L0.002	0.005	L0.04	L0.004
DEC	L.0005	0.10	0.15	L0.001	L0.002	0.005	L0.04	L0.004
JAN	L.0005	0.13	0.27	L0.001	L0.002	0.003	0.08	L0.004
FEB	L.0005	0.13	0.23	L0.001	L0.002	0.004	0.08	L0.004
MAR	L.0005	0.08	0.25	L0.001	L0.002	0.004	0.15	0.005
OBJECTIVE	0.01	1.0	0.5	0.1		0.02	0.3	0.05

TABLE 8

BATTLE RIVER
(All values in mg.L unless otherwise noted)

NEAR UNWIN	MANGANESE (diss)	MERCURY (total-(ug.L)	NICKEL (total)	SELENIUM (diss)	SILVER (extbl)	VANADIUM (total)	ZINC (total)
NOV	L0.01	0.02	0.003	L.0005	-	0.001	0.004
DEC	0.02	L0.02	0.006	L.0005	-	L0.001	0.003
JAN	0.04	L0.02	L0.002	L.0005	-	L0.001	0.001
FEB	0.04	L0.02	L0.002	L.0005	-	L0.001	0.004
MAR	0.03	L0.02	L0.002	L.0005	-	L0.001	NV
OBJECTIVE	0.05	0.1		0.01	0.05		0.05

TABLE 9

BATTLE RIVER
(all values in ug.L)

NEAR UNWIN	NOV	DEC	JAN	FEB	MAR
2,4-DB	L0.009	L0.009	L0.009	L0.009	L0.009
2,4,5-T	L0.002	L0.002	L0.002	L0.002	L0.002
2,4-DP	L0.004	L0.004	L0.004	L0.004	L0.004
AROCLOR 1242	L0.002	L0.002	L0.002	L0.002	L0.002
AROCLOR 1260	L0.005	L0.005	L0.005	L0.005	L0.005
ALPHA-BHC	0.008	0.003	0.003	0.001	0.001
GAMMA-CHLORDANE	L0.002	L0.002	L0.002	L0.002	L0.002
P,P-'DDE	L0.001	L0.001	L0.001	L0.001	L0.001
O,P'-DDT	L0.001	L0.001	L0.001	L0.001	L0.001
GUTHION	-	-	-	-	-
IMIDAN	-	-	-	-	-
RUELENE	-	-	-	-	-
METHYL PARATHION	-	-	-	-	-
RONNEL	-	-	-	-	-
PHORATE	-	-	-	-	-
TRITHION	-	-	-	-	-
BETA-ENDOSULFAN	L0.003	L0.003	L0.003	L0.003	L0.003
HEPTACHLOR	L0.001	L0.001	L0.001	L0.001	L0.001
LINDANE	0.001	L0.001	L0.001	L0.001	L0.001
METHOXYCHLOR	L0.01	L0.01	L0.01	L0.01	L0.01
MIREX	L0.001	L0.001	L0.001	L0.001	L0.001

TABLE 9

BATTLE RIVER
(all values in ug.L)

NEAR UNWIN	NOV	DEC	JAN	FEB	MAR
2,4-D	0.02	L0.004	0.01	0.009	L0.004
ALDRIN	L0.001	L0.001	L0.001	L0.001	L0.001
AROCLOR 1254	L0.002	L0.002	L0.002	L0.002	L0.002
AROCLOR TOTAL	L0.002	L0.002	L0.002	L0.002	L0.002
ALPHA-CHLORDANE	L0.003	L0.003	L0.003	L0.003	L0.003
P,P'-DDD	L0.002	L0.002	L0.002	L0.002	L0.002
P,P'-DDT	L0.004	L0.004	L0.004	L0.004	L0.004
DIELDRIN	-	-	-	-	-
ETHYL GUTHION	-	-	-	-	-
DISULFOTON	-	-	-	-	-
PARATHION	-	-	-	-	-
MALATHION	-	-	-	-	-
DIAZINON	-	-	-	-	-
ETHION	-	-	-	-	-
ALPHA-ENDOSULFAN	L0.001	L0.001	L0.001	L0.001	L0.001
ENDRIN	L0.002	L0.002	L0.002	L0.002	L0.002
HEPTACHLOR EPOXIDE	L0.002	L0.002	L0.002	L0.002	L0.002
MCPA	L0.2	L0.2	L0.2	L0.2	L0.2
SILVEX	L0.004	L0.004	L0.004	L0.004	L0.004
HCB	L0.001	L0.001	L0.001	L0.001	L0.001
MIREX	L0.001	L0.001	L0.001	L0.001	L0.001

NORTH SASKATCHEWAN RIVER BASIN - NORTH SASKATCHEWAN RIVER

Three stations were sampled on the North Saskatchewan River. At Devon, upstream of Edmonton, all parameters met surface water objectives. Downstream of Edmonton, at both Pakan Bridge and Lea Park (near the border), phosphorus failed to meet the objective values (Table 2) the main increase being in the soluble form. Nitrogen also increased at the downstream stations. In addition total coliforms exceeded primary contact objectives in the latter three months at both downstream sites and fecal coliforms in the last three months at Pakan and in January at Lea Park (Table 4).

These values all indicate that municipal sewage discharges from the Edmonton region has the main impact on the river. This organic discharge does not, however, have a major effect on the oxygen content of the river, which would be the prime concern during the winter months (Table 1).

Most of the metal parameters showed little or no change at the sampling stations, which confirmed that the main effects on water quality are increases in the nutrient and bacteriological parameters.

TABLE 1

NORTH SASK RIVER
(All values in mg/L unless otherwise noted)

AT DEVON

	OXYGEN	CONDUCTIVITY (us/cm)	PH (pH units)	TEMPERATURE (Deg C)	TURBIDITY (JTU)	COLOUR (Ret Units)	RESIDUE N.F.
NOV	12.9	311.	8.3	NV	2.7	10.	2.
DEC	12.7	322.	8.1	0.0	3.0	5.	5.
JAN	13.5	314.	7.9	0.0	3.8	5.	4.
FEB	12.7	346.	7.9	0.0	1.5	10.	4.
MAR	12.0	291.	8.1	0.0	2.4	L5.	3.
OBJECTIVE	G5.0						

TABLE 2

NORTH SASK RIVER
(All values in mg.L unless otherwise noted)

AT DEVON

	PHOSPHORUS (Total as P)	PHOSPHORUS (Total Soluble)	PHOSPHORUS (Particulate)	NITROGEN (Tot Ammonia as N)	NITROGEN (Diss as N)L
NOV	0.012	0.004	0.008	L0.1	0.08
DEC	0.014	0.005	0.009	L0.1	0.11
JAN	0.009	L0.003	0.007	L0.1	0.11
FEB	0.007	L0.003	L0.006	L0.1	0.12
MAR	0.006	0.003	L0.006	L0.1	0.17
OBJECTIVE	0.050				

TABLE 3

NORTH SASK RIVER
(All values in mg.L unless otherwise noted)

AT DEVON

	NITROGEN (Diss NO_3 + NO_2 as N)	NITROGEN (Total as N)	NITROGEN (Diss as N)F	NITROGEN (Part as N)L	CARBON (Diss Org as C)L
NOV	L0.01	0.08	0.08	L0.01	3.0
DEC	0.05	0.11	0.11	L0.01	1.7
JAN	0.07	0.11	0.11	L0.01	1.8
FEB	0.07	0.12	0.11	L0.01	3.3
MAR	0.09	0.17	0.19	L0.01	1.6
OBJECTIVE		1.00			

TABLE 4

NORTH SASK RIVER
(All values in mg.L unless otherwise noted)

AT DEVON

	CARBON (Part Org as C)	PHENOLICS	TOTAL COLIFORMS (no. 100 mL)	FECAL STREPTOCOCCUS (no. 100 mL)	FECAL COLIFORMS (no. 100 mL)
NOV	0.13	0.001	5.	25.	L2.
DEC	0.23	0.002	4.	2.	2.
JAN	0.22	0.001	L2.	106.	L2.
FEB	L0.01	0.002	4.	60.	L2.
MAR	0.20	0.002	10.	280.	10.
OBJECTIVE		0.005	L1000		L200

TABLE 5

NORTH SASK RIVER
(All values in mg.L unless otherwise noted)

AT DEVON	ALKALINITY	HARDNESS (Total as $CaCO_3$)	MAGNESIUM	CALCIUM	POTASSIUM	SODIUM	SILICA (Reactive)
NOV	131.	144.6	11.4	39.1	0.8	5.1	3.8
DEC	130.	166.3	13.4	44.5	0.7	4.0	4.2
JAN	125.	161.9	12.5	44.2	0.7	3.5	4.3
FEB	140.	172.0	13.7	46.3	0.7	4.3	4.9
MAR	120.	155.9	12.4	42.0	0.7	3.2	4.0
OBJECTIVE	1.5						

TABLE 6

NORTH SASK RIVER
(All values in mg.L unless otherwise noted)

AT DEVON

	FLUORIDE	CHLORIDE	SULPHATE	CARBONATE	BICARBONATE	HYDROXIDE	TOTAL DISSOLVED SOLIDS
NOV	0.14	0.7	31.	0.0	159.7	0.0	170.6
DEC	0.12	0.8	36.	0.0	158.5	0.0	181.9
JAN	0.10	0.5	36.	0.0	152.4	0.0	177.1
FEB	0.10	0.6	40.	0.0	170.7	0.0	194.9
MAR	0.10	0.6	36.	0.0	146.3	0.0	171.4
OBJECTIVE	1.5						

TABLE 7

NORTH SASK RIVER
(All values in mg.L unless otherwise noted)

AT DEVON	ARSENIC (diss)	BARIUM (total)	BORON (diss)	CADMIUM (total)	COBALT (total)	COPPER (total)	IRON (diss)	LEAD (total)
NOV	L.0005	-	0.07	-	-	-	L0.04	-
DEC	L.0005	-	0.05	-	-	-	L0.04	-
JAN	L.0005	0.06	0.04	L0.001	L0.002	0.001	L0.04	L0.004
FEB	L.0005	-	0.02	-	-	-	L0.04	-
MAR	L.0005	-	L0.02	-	-	-	L0.04	-
OBJECTIVE	0.01	1.0	0.5	0.01		0.02	0.3	0.05

TABLE 8

NORTH SASK RIVER

AT DEVON	MANGANESE (diss)	MERCURY (total-(ug.L)	NICKEL (total)	SELENIUM (diss)	SILVER (extbl)	VANADIUM (total)	ZINC (total)
NOV	L0.01	L0.02	-	L.0005	-	-	-
DEC	L0.01	L0.02	-	L.0005	-	-	-
JAN	L0.01	L0.02	-	L.0005	L.004	L0.001	0.001
FEB	L0.01	L0.02	-	L.0005	-	-	-
MAR	L0.01	L0.02	-	L.0005	-	-	-
MEAN							
OBJECTIVE	0.05	0.1		0.01	0.05		0.05

TABLE 1

NORTH SASK RIVER
(All values in mg/L unless otherwise noted)

AT LEA PARK

	OXYGEN	CONDUCTIVITY (us/cm)	PH (pH units)	TEMPERATURE (Deg C)	TURBIDITY (JTU)	COLOUR (Ret Units)	RESIDUE N.F.
NOV	14.6	360.	8.3	0.0	2.9	10.	2.
DEC	12.8	380.	7.8	0.0	1.8	10.	3.
JAN	10.1	346.	7.8	0.0	3.0	10.	4.
FEB	8.8	388.	7.7	0.0	2.5	10.	4.
MAR	10.4	333.	NV	0.0	3.5	10.	4.

AT PAKAN

	OXYGEN	CONDUCTIVITY (us/cm)	PH (pH units)	TEMPERATURE (Deg C)	TURBIDITY (JTU)	COLOUR (Rel Units)	RESIDUE N.F.
NOV	13.6	332.	8.3	3.0	NV	20.	5.
DEC	12.6	364.	7.7	0.0	2.0	10.	3.
JAN	12.6	336.	7.8	0.0	3.2	5.	3.
FEB	11.8	362.	7.9	0.0	5.0	10.	5.
MAR	11.5	312.	8.0	1.0	5.2	10.	7.

OBJECTIVE G5.0

TABLE 2

NORTH SASK RIVER
(All values in mg.L unless otherwise noted)

AT LEA PARK

	PHOSPHORUS (Total as P)	PHOSPHORUS (Total Soluble)	PHOSPHORUS (Particulate)	NITROGEN (Tot Ammonia as N)	NITROGEN (Diss as N)L
NOV	0.050	0.037	0.013	L0.1	0.37
DEC	0.095	0.090	L0.006	0.4	0.61
JAN	0.086	0.074	0.012	0.5	0.77
FEB	0.12	0.096	0.024	0.3	0.70
MAR	0.087	0.077	0.010	0.3	0.67

AT PAKAN

	PHOSPHORUS (Total as P)	PHOSPHORUS (Total Soluble)	PHOSPHORUS (Particulate)	NITROGEN (Tot Ammonia as N)	NITROGEN (Diss as N)L
NOV	0.068	0.056	0.012	0.4	0.38
DEC	0.086	0.082	L0.006	0.4	0.45
JAN	0.12	0.082	0.04	0.3	0.38
FEB	0.11	0.091	0.019	0.2	0.43
MAR	0.11	0.089	0.021	L0.1	0.46

OBJECTIVE 0.050

TABLE 3

NORTH SASK RIVER
(All values in mg.L unless otherwise noted)

AT LEA PARK

	NITROGEN (Diss NO_3 + NO_2 as N)	NITROGEN (Total as N)	NITROGEN (Diss as N)F	NITROGEN (Part as N)L	CARBON (Diss Org as C)L
NOV	0.24	0.37	0.39	L0.01	3.0
DEC	0.52	0.61	0.88	L0.01	3.3
JAN	0.31	0.81	0.82	0.04	2.1
FEB	0.49	0.76	0.72	0.06	2.5
MAR	0.50	0.72	0.66	0.05	1.8

AT PAKAN

	NITROGEN (Diss NO3 + NO2 as N)	NITROGEN (Total as N)	NITROGEN (Diss as N)F	NITROGEN (Part as N)L	CARBON (Diss Org as C)
NOV	0.15	0.38	0.42	L0.01	3.1
DEC	0.21	0.45	0.54	L0.01	2.3
JAN	0.18	0.38	0.40	L0.01	1.9
FEB	0.23	0.49	0.49	0.06	3.6
MAR	0.26	0.35	0.48	0.09	1.4

OBJECTIVE 1.00

TABLE 4

NORTH SASK RIVER
(All values in mg.L unless otherwise noted)

AT LEA PARK

	CARBON (Part Org as C)L	PHENOLICS	TOTAL COLIFORMS (no. 100 mL)	FECAL STREPTOCOCCUS (no. 100 mL)	FECAL COLIFORMS (no. 100 mL)
NOV	3.0	0.003	20.	-	L2.
DEC	3.3	0.001	150.	-	16.
JAN	2.1	0.002	1900.	-	510.
FEB	2.5	0.001	2400.	-	122.
MAR	1.8	0.002	3900.	-	130.

AT PAKAN

	CARBON (Part Org as C)L	PHENOLICS	TOTAL COLIFORMS (no. 100 mL)	FECAL STREPTOCOCCUS (no. 100 mL)	FECAL COLIFORMS (no. 100 mL)
NOV	3.1	0.001	170.	20.	L10.
DEC	0.17	0.001	800.	40.	98.
JAN	0.31	0.002	2200.	190.	1025.
FEB	0.48	0.001	2200.	118.	445.
MAR	1.4	0.003	6400.	180.	670.

OBJECTIVE		0.005	L1000		L200

TABLE 5

NORTH SASK RIVER
(All values in mg.L unless otherwise noted)

AT LEA PARK

	ALKALINITY	HARDNESS (Total as $CaCO_3$)	MAGNESIUM	CALCIUM	POTASSIUM	SODIUM	SILICA (Reactive)
NOV	140.	157.5	12.6	12.3	1.3	9.0	1.7
DEC	150.	184.5	14.3	50.3	1.2	6.6	4.6
JAN	135.	168.8	13.7	45.0	1.0	6.2	4.8
FEB	145.	184.1	14.5	49.8	1.2	10.	5.6
MAR	122.	157.0	12.6	42.1	1.0	8.1	4.0

AT PAKAN

	ALKALINITY	HARDNESS (Total as $CaCO_3$)	MAGNESIUM	CALCIUM	POTASSIUM	SODIUM	SILICA (Reactive)
NOV	135.	168.7	13.5	45.3	1.1	7.5	3.0
DEC	138.	177.6	14.2	47.7	1.1	6.0	4.3
JAN	130.	174.5	13.5	47.6	1.0	5.1	4.5
FEB	145.	184.7	14.6	49.9	1.0	6.7	5.2
MAR	130.	162.5	12.9	13.8	0.9	6.2	4.2

OBJECTIVE 1.5

TABLE 6

NORTH SASK RIVER
(All values in mg.L unless otherwise noted)

AT LEA PARK

	FLUORIDE	CHLORIDE	SULPHATE	CARBONATE	BICARBONATE	HYDROXIDE	TOTAL DISSOLVED SOLIDS
NOV	0.20	4.3	41.	0.0	170.7	0.0	197.5
DEC	0.15	2.9	46.	0.0	182.8	0.0	218.4
JAN	0.12	2.9	39.	0.0	164.6	0.0	195.1
FEB	0.19	7.6	46.	0.0	176.8	0.0	224.1
MAR	0.08	5.0	40.	0.0	148.7	0.0	188.3

AT PAKAN

	FLUORIDE	CHLORIDE	SULPHATE	CARBONATE	BICARBONATE	HYDROXIDE	TOTAL DISSOLVED SOLIDS
NOV	0.18	2.6	39.	0.0	164.6	0.0	193.8
DEC	0.18	2.7	40.	0.0	168.2	0.0	199.9
JAN	0.13	1.9	40.	0.0	158.5	0.0	192.5
FEB	0.12	2.2	42.	0.0	176.8	0.0	209.7
MAR	0.11	2.5	40.	0.0	158.5	0.0	189.8

OBJECTIVE	1.5

TABLE 7

NORTH SASK RIVER
(All values in mg.L unless otherwise noted)

AT LEA PARK

	ARSENIC (diss)	BARIUM (total)	BORON (diss)	CADMIUM (total)	COBALT (total)	COPPER (total)	IRON (diss)	LEAD (total)
NOV	L.0005	0.08	0.03	L0.001	L0.002	0.001	L0.04	L0.004
DEC	L.0005	0.06	0.04	L0.001	L0.002	0.002	L0.04	L0.004
JAN	L.0005	0.06	0.08	L0.001	L0.002	L0.001	L0.04	L0.004
FEB	L.0005	L0.05	0.04	L0.001	L0.002	L0.001	L0.04	L0.004
MAR	L.0005	0.05	0.07	L0.001	L0.002	0.002	L0.04	0.004

AT PAKAN

	ARSENIC (diss)	BARIUM (total)	BORON (diss)	CADMIUM (total)	COBALT (total)	COPPER (total)	IRON (diss)	LEAD (total)
NOV	L.0005	-	0.06	-	-	-	L0.04	-
DEC	L.0005	-	0.13	-	-	-	L0.04	-
JAN	L.0005	0.07	0.08	L0.001	L0.002	0.002	L0.04	L0.004
FEB	0.0005	-	0.06	-	-	-	L0.04	-
MAR	L.0005	-	0.03	-	-	-	L0.04	-

OBJECTIVE	0.01	1.0	0.5	0.1		0.02	0.3	0.05

TABLE 8

NORTH SASK RIVER
(All values in mg.L unless otherwise noted)

AT LEA PARK

	MANGANESE (diss)	MERCURY (total-(ug.L)	NICKEL (total)	SELENIUM (diss)	SILVER (extbl)	VANADIUM (total)	ZINC (total)
NOV	L0.01	L0.02	L0.002	L.0005	-	L0.001	0.005
DEC	L0.01	L0.02	0.005	L.0005	-	L0.001	0.001
JAN	L0.01	L0.02	0.003	L.0005	-	L0.001	0.002
FEB	L0.01	L0.02	0.002	L.0005	-	L0.001	0.003
MAR	L0.01	L0.02	L0.002	L.0005	-	L0.001	NV

AT PAKAN

	MANGANESE (diss)	MERCURY total-(ug.L)	NICKEL (total)	SELENIUM (diss)	SILVER (extbl)	VANADIUM (total)	ZINC (total)
NOV	L0.01	0.02	-	L.0005	-	-	-
DEC	L0.01	L0.02	-	L.0005	-	-	-
JAN	L0.01	L0.02	L0.002	L.0005	L0.004	L0.001	0.004
FEB	L0.01	L0.02	-	L.0005	-	-	-
MAR	L0.01	L0.02	-	L.0005	-	-	-

OBJECTIVE	0.05	0.1		0.01	0.05		0.05

TABLE 9

NORTH SASK RIVER
(all values in ug.L)

AT LEA PARK	NOV	DEC	JAN	FEB	MAR
2,4-D	0.3	0.3	0.2	0.2	NV
ALDRIN	L0.001	L0.001	L0.001	L0.001	L0.001
AROCLOR 1254	L0.002	L0.002	L0.002	L0.002	L0.002
AROCLOR TOTAL	L0.002	L0.002	L0.002	L0.002	L0.002
ALPHA-CHLORDANE	L0.003	L0.003	L0.003	L0.003	L0.003
P,P'-DDD	L0.002	L0.002	L0.002	L0.002	L0.002
P,P'-DDT	L0.004	L0.004	L0.001	L0.004	L0.004
DIELDRIN	L0.002	L0.002	L0.002	L0.002	L0.002
ETHYL GUTHION	-	-	-	-	-
DISULFOTON	-	-	-	-	-
PARATHION	-	-	-	-	-
MALATHION	-	-	-	-	-
DIAZINON	-	-	-	-	-
ETHION	-	-	-	-	-
ALPHA-ENDOSULFAN	L0.002	L0.003	L0.001	L0.001	L0.001
ENDRIN	L0.002	L0.002	L0.002	L0.002	L0.002
HEPTACHLOR EPOXIDE	L0.002	L0.002	L0.002	L0.002	L0.002
MCPA	L0.2	L0.2	L0.2	L0.2	L0.2
SILVEX	L0.004	L0.004	L0.004	L0.004	L0.004
HCB	L0.001	L0.001	L0.001	L0.001	L0.001
MIREX	L0.001	L0.001	L0.001	L0.001	L0.001

TABLE 9

NORTH SASK RIVER
(all values in ug.L)

AT LEA PARK	NOV	DEC	JAN	FEB	MAR
2,4-DB	L0.009	L0.009	L0.009	L0.009	NV
2,4,5-T	L0.002	L0.002	L0.002	L0.009	NV
2,4-DP	L0.004	L0.004	L0.004	L0.004	NV
AROCLOR 1242	L0.002	L0.002	L0.002	L0.002	L0.002
AROCLOR 1260	L0.005	L0.005	L0.005	L0.005	L0.005
ALPHA-BHC	0.003	0.001	0.002	L0.001	L0.001
GAMMA-CHLORDANE	L0.003	L0.002	L0.002	L0.002	L0.002
P,P-'DDE	L0.001	L0.001	L0.001	L0.001	L0.001
O,P'-DDT	L0.001	L0.001	L0.001	L0.001	L0.001
GUTHION	-	-	-	-	-
IMIDAN	-	-	-	-	-
RUELENE	-	-	-	-	-
METHYL PARATHION	-	-	-	-	-
RONNEL	-	-	-	-	-
PHORATE	-	-	-	-	-
TRITHION	-	-	-	-	-
BETA-ENDOSULFAN	L0.003	L0.003	L0.003	L0.003	L0.003
HFPTACHLOR	L0.001	L0.001	L0.001	L0.001	L0.001
LINDANE	0.003	L0.001	L0.001	L0.001	L0.001
METHOXYCHLOR	L0.01	L0.01	L0.01	L0.1	L0.1
MIREX	L0.001	L0.001	L0.001	L0.001	L0.001

TABLE 9

NORTH SASK RIVER
(all values in ug.L)

AT PAKAN	JAN		JAN
2,4-D	0.1	2,4-DB	L0.009
ALDRIN	L0.001	2,4,5-T	L0.002
AROCLOR 1254	L0.002	2,4-DP	L0.004
AROCLOR TOTAL	L0.002	AROCLOR 1242	L0.002
ALPHA-CHLORDANE	L0.003	AROCLOR 1260	L0.005
P,P'-DDD	L0.002	ALPHA-BHC	0.002
P,P'-DDT	L0.004	GAMMA-CHLORDANE	L0.003
DIELDRIN	L0.002	P,P-'DDE	L0.001
ETHYL GUTHION	L0.2	O,P'-DDT	L0.001
DISULFOTON	L0.02	GUTHION	L0.5
PARATHION	L0.02	IMIDAN	L0.2
MALATHION	L0.05	RUELENE	L0.2
DIAZINON	L0.02	METHYL PARATHION	L0.02
ETHION	L0.02	RONNEL	L0.02
ALPHA-ENDOSULFAN	L0.001	PHORATE	L0.02
ENDRIN	L0.002	TRITHION	L0.02
HEPTACHLOR EPOXIDE	L0.002	BETA-ENDOSULFAN	L0.003
MCPA	L0.2	HEPTACHLOR	L0.001
SILVEX	L0.004	LINDANE	L0.001
HCB	L0.001	METHOXYCHLOR	L0.01
MIREX	L0.001		

TABLE 9

NORTH SASK RIVER
(all values in ug.L)

AT DEVON	JAN		JAN
2,4-D	L0.004	2,4-DB	L0.009
ALDRIN	L0.001	2,4,5-T	L0.002
AROCLOR 1254	L0.002	2,4-DP	L0.004
AROCLOR TOTAL	L0.002	AROCLOR 1242	L0.002
ALPHA-CHLORDANE	L0.003	AROCLOR 1260	L0.005
P,P'-DDD	L0.002	ALPHA-BHC	0.002
P,P'-DDT	L0.004	GAMMA-CHLORDANE	L0.002
DIELDRIN	L0.002	P,P-'DDE	L0.001
ETHYL GUTHION	L0.2	O,P'-DDT	L0.001
DISULFOTON	L0.02	GUTHION	L0.5
PARATHION	L0.02	IMIDAN	L0.2
MALATHION	L0.05	RUELENE	L0.2
DIAZINON	L0.02	METHYL PARATHION	L0.02
ETHION	L0.02	RONNEL	L0.02
ALPHA-ENDOSULFAN	L0.001	PHORATE	L0.02
ENDRIN	L0.002	TRITHION	L0.02
HEPTACHLOR EPOXIDE	L0.002	BETA-ENDOSULFAN	L0.003
MCPA	L0.2	HEPTACHLOR	L0.001
SILVEX	L0.004	LINDANE	L0.001
HCB	L0.001	METHOXYCHLOR	L0.01
MIREX	L0.001		

BEAVER RIVER

This site was downstream of a number of municipal discharges in the Cold Lake region. The main observation on the water quality at this site was the apparently high level of productivity in the river, reflected by the high nutrient and dissolved organic carbon values (Tables 2 & 3). Consequently, the oxygen levels were extremely low during the ice cover period. The parameters which did not meet the objectives were dissolved oxygen, phosphorus and nitrogen.

The low bacterial levels (Table 4) suggest that the high nutrient status of the river may be due to natural phenomena or diffuse sources rather than point source municipal effluents.

ATHABASCA RIVER

All parameters met objectives at the Athabasca station.

TABLE 1

BEAVER AND ATHABASCA RIVERS
(All values in mg/L unless otherwise noted)

BEAVER AT BEAVER CROSSING

	OXYGEN	CONDUCTIVITY (us/cm)	PH (pH units)	TEMPERATURE (Deg C)	TURBIDITY (JTU)	COLOUR (Ret Units)	RESIDUE N.F.
NOV	10.0	600.	7.7	0.0	4.6	30.	3.
DEC	0.6	615.	7.2	0.0	5.0	20.	5.
JAN	0.8	582.	7.2	0.0	5.5	20.	8.
FEB	1.1	549.	7.1	1.0	2.5	30.	6.
MAR	3.2	528.	7.1	1.0	6.0	30.	4.

ATHABASCA AT ATHABASCA

	OXYGEN	CONDUCTIVITY (us/cm)	PH (pH units)	TEMPERATURE (Deg C)	TURBIDITY (JTU)	COLOUR (Rel Units)	RESIDUE N.F.
NOV	13.7	301.	8.1	1.5	NV	20.	8.
DEC	12.6	473.	7.9	0.0	4.0	30.	6.
JAN	11.7	415.	7.8	0.5	2.0	20.	2.
FEB	10.1	417.	7.7	0.0	3.0	20.	L1.
MAR	9.4	380.	NV	0.0	3.8	30.	2.

OBJECTIVE GO.5

TABLE 2

BEAVER AND ATHABASCA RIVERS
(All values in mg.L unless otherwise noted)

BEAVER AT BEAVER CROSSING

	PHOSPHORUS (Total as P)	PHOSPHORUS (Total Soluble)	PHOSPHORUS (Particulate)	NITROGEN (Tot Ammonia as N)	NITROGEN (Diss as N)L
NOV	0.069	0.043	0.026	L0.1	0.68
DEC	0.074	0.028	0.046	0.3	0.65
JAN	0.090	0.015	0.075	0.9	0.51
FEB	0.078	0.027	0.051	0.5	0.80
MAR	0.087	0.033	0.054	0.7	1.0

ATHABASCA AT ATHABASCA

	PHOSPHORUS (Total as P)	PHOSPHORUS (Total Soluble)	PHOSPHORUS (Particulate)	NITROGEN (Tot Ammonia as N)	NITROGEN (Diss as N)L
NOV	0.015	0.005	0.010	L0.1	L0.01
DEC	0.013	0.006	0.007	L0.1	0.28
JAN	0.026	0.006	0.020	L0.1	0.27
FEB	0.017	0.004	0.013	L0.1	0.29
MAR	0.015	0.006	0.009	L0.1	0.28

OBJECTIVE 0.050

TABLE 3

BEAVER AND ATHABASCA RIVERS
(All values in mg.L unless otherwise noted)

BEAVER AT BEAVER CROSSING

	NITROGEN (Diss NO_3 + NO_2 as N)	NITROGEN (Total as N)	NITROGEN (Diss as N)F	NITROGEN (Part as N)L	CARBON (Diss Org as C)L
NOV	0.21	0.68	0.65	L0.01	13.
DEC	0.16	0.71	0.73	0.06	14.
JAN	0.07	0.58	0.50	0.07	12.
FEB	0.20	0.86	0.75	0.06	12.
MAR	0.33	1.6	1.1	0.10	11.

ATHABASCA AT ATHABASCA

	NITROGEN (Diss NO_3 + NO_2 as N)	NITROGEN (Total as N)	NITROGEN (Diss as N)F	NITROGEN (Part as N)L	CARBON (Diss Org as C)
NOV	0.02	0.17	0.17	L0.01	4.7
DEC	0.07	0.28	0.27	L0.01	6.1
JAN	0.11	0.27	0.26	L0.01	5.3
FEB	0.16	0.29	0.29	L0.01	6.5
MAR	0.15	0.28	0.29	L0.01	5.1

OBJECTIVE	1.0

TABLE 4

BEAVER AND ATHABASCA RIVERS
(All values in mg.L unless otherwise noted)

BEAVER AT BEAVER CROSSING

	CARBON (Part Org as C)L	PHENOLICS	TOTAL COLIFORMS (no. 100 mL)	FECAL STREPTOCOCCUS (no. 100 mL)	FECAL COLIFORMS (no. 100 mL)
NOV	4.0	0.003	4.	-	2.
DEC	0.40	0.002	2.	-	L2.
JAN	0.50	0.002	8.	-	L2.
FEB	0.32	0.003	4.	-	L2.
MAR	0.57	0.003	28.	-	4.

ATHABASCA AT ATHABASCA

	CARBON (Part Org as C)L	PHENOLICS	TOTAL COLIFORMS (no. 100 mL)	FECAL STREPTOCOCCUS (no. 100 mL)	FECAL COLIFORMS (no. 100 mL)
NOV	0.44	0.001	G800.	-	10.
DEC	0.28	0.002	14.	-	L2.
JAN	0.21	0.002	16.	-	8.
FEB	0.06	0.003	9.	-	4.
MAR	0.26	0.002	NV	NV	NV

OBJECTIVE		0.005	L2000.		L200.

TABLE 5

BEAVER AND ATHABASCA RIVERS
(All values in mg.L unless otherwise noted)

BEAVER AT BEAVER CROSSING	ALKALINITY	HARDNESS (Total as $CaCO_3$)	MAGNESIUM	CALCIUM	POTASSIUM	SODIUM	SILICA (Reactive)
NOV	300.	242.5	22.5	60.0	2.7	32.	8.2
DEC	310.	275.3	24.7	69.5	2.6	27.	14.
JAN	295.	260.1	24.1	64.4	2.8	29.	15.
FEB	290.	250.4	23.2	62.0	2.7	30.	15.
MAR	275.	241.6	23.5	58.0	3.2	31.	14.

ATHABASCA AT ATHABASCA	ALKALINITY	HARDNESS (Total as $CaCO_3$)	MAGNESIUM	CALCIUM	POTASSIUM	SODIUM	SILICA (Reactive)
NOV	136.	137.3	10.3	38.0	1.0	7.5	4.7
DEC	201.	220.6	16.7	60.8	1.4	11.	7.2
JAN	180.	196.4	14.4	54.9	1.6	12.	6.2
FEB	175.	175.	15.1	54.4	1.4	12.	6.4
MAR	160.	188.3	14.2	52.0	1.5	12.	5.4

OBJECTIVE	1.5

TABLE 6

BEAVER AND ATHABASCA RIVERS
(All values in mg.L unless otherwise noted)

BEAVER AT BEAVER CROSSING

	FLUORIDE	CHLORIDE	SULPHATE	CARBONATE	BICARBONATE	HYDROXIDE	TOTAL DISSOLVED SOLIDS
NOV	0.23	6.7	22.	0.0	365.7	0.0	335.3
DEC	0.16	7.0	22.	0.0	377.9	0.0	353.7
JAN	0.14	5.7	19.	0.0	359.6	0.0	337.5
FEB	0.17	6.3	17.	0.0	353.5	0.0	331.3
MAR	0.10	7.5	20.	0.0	335.2	0.0	323.8

ATHABASCA AT ATHABASCA

	FLUORIDE	CHLORIDE	SULPHATE	CARBONATE	BICARBONATE	HYDROXIDE	TOTAL DISSOLVED SOLIDS
NOV	0.14	1.6	25.	0.0	165.8	0.0	169.9
DEC	0.18	5.5	36.	0.0	245.0	0.0	259.7
JAN	0.12	4.7	35.	0.0	219.4	0.0	237.4
FEB	0.09	5.1	38.	0.0	213.3	0.0	238.2
MAR	0.13	5.5	38.	0.0	195.0	0.0	225.4

OBJECTIVE 1.5

TABLE 7

BEAVER AND ATHABASCA RIVERS
(All values in mg.L unless otherwise noted)

BEAVER AT BEAVER CROSSING

	ARSENIC (diss)	BARIUM (total)	BORON (diss)	CADMIUM (total)	COBALT (total)	COPPER (total)	IRON (diss)	LEAD (total)
NOV	L.0005	0.08	0.13	L0.001	L0.002	0.005	0.08	L0.004
DEC	L.0005	0.08	0.16	L0.001	L0.002	L0.001	0.08	L0.004
JAN	0.0009	0.08	0.16	L0.001	L0.002	L0.001	0.07	L0.004
FEB	0.0006	0.08	0.14	L0.001	L0.002	0.001	0.05	L0.004
MAR	L.0005	0.07	0.18	L0.001	L0.002	0.002	0.09	0.005

ATHABASCA AT ATHABASCA

	ARSENIC (diss)	BARIUM (total)	BORON (diss)	CADMIUM (total)	COBALT (total)	COPPER (total)	IRON (diss)	LEAD (total)
NOV	L.0005	-	0.07	-	-	-	0.08	-
DEC	L.0005	-	0.15	-	-	-	0.09	-
JAN	L.0005	0.10	0.05	L0.001	L0.002	L0.001	0.05	L0.004
FEB	L.0005	-	0.05	-	-	-	L0.04	-
MAR	L.0005	-	0.04	-	-	-	0.04	-

OBJECTIVE	0.01	1.0	0.5	0.1		0.02	0.3	0.05

TABLE 8

BEAVER AND ATHABASCA RIVERS
(All values in mg.L unless otherwise noted)

BEAVER AT BEAVER CROSSING

	MANGANESE (diss)	MERCURY (total-(ug.L)	NICKEL (total)	SELENIUM (diss)	SILVER (extbl)	VANADIUM (total)	ZINC (total)
NOV	0.08	L0.02	L0.002	L.0005	-	L0.001	0.003
DEC	1.3	L0.02	0.002	L.0005	-	L0.001	0.001
JAN	1.5	L0.02	L0.002	L.0005	-	L0.001	L0.001
FEB	1.0	L0.02	L0.002	L.0005	-	L0.001	0.003
MAR	0.46	0.03	L0.002	L.0005	-	L0.001	NV

ATHABASCA AT ATHABASCA

	MANGANESE (diss)	MERCURY total-(ug.L)	NICKEL (total)	SELENIUM (diss)	SILVER (extbl)	VANADIUM (total)	ZINC (total)
NOV	L0.01	L0.02	-	L.0005	-	-	-
DEC	L0.01	L0.02	-	L.0005	-	-	-
JAN	L0.01	L0.02	L0.002	L.0005	L0.004	L0.001	0.003
FEB	L0.01	L0.02	-	L.0005	-	-	-
MAR	L0.02	L0.02	-	L.0005	-	-	-
OBJECTIVE	0.05	0.1		0.01	0.05		0.05

BEAVER AND ATTACHED LEAVES
(a[illegible]val[illegible]in [illegible])

BEAVER AT BEAVER	NOV	DEC	JAN	FEB	MAR
2,4-D	L0.004	L0.009	L0.004	L0.004	0.06
ALDRIN	L0.001	L0.001	L0.001	L0.001	L0.001
AROCLOR 1254	L0.002	L0.002	L0.002	L0.002	L0.002
AROCLOR TOTAL	L0.002	L0.002	L0.002	L0.002	L0.002
ALPHA-CHLORDANE	L0.003	L0.003	L0.003	L0.003	L0.003
P,P'-DDD	L0.002	L0.002	L0.002	L0.002	L0.002
P,P'-DDT	L0.004	L0.004	L0.004	L0.004	L0.004
DIELDRIN	L0.002	L0.002	L0.002	L0.002	L0.002
ETHYL GUTHION	-	-	-	-	-
DISULFOTON	-	-	-	-	-
PARATHION	-	-	-	-	-
MALATHION	-	-	-	-	-
DIAZINON	-	-	-	-	-
ETHION	-	-	-	-	-
ALPHA-ENDOSULFAN	L0.001	L0.001	L0.001	L0.001	L0.001
ENDRIN	L0.002	L0.002	L0.002	L0.002	L0.002
HEPTACHLOR EPOXIDE	L0.002	L0.002	L0.002	L0.002	L0.002
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

TABLE 9

BEAVER AND ATHABASCA RIVERS
(all values in ug.L)

BEAVER AT BEAVER	NOV	DEC	JAN	FEB	MAR
2,4-DB	L0.009	L0.009	L0.009	L0.009	L0.009
2,4,5-T	L0.002	L0.002	L0.002	L0.002	L0.002
2,4-DP	L0.004	L0.004	L0.004	L0.004	L0.004
AROCLOR 1242	L0.002	L0.002	L0.002	L0.002	L0.002
AROCLOR 1260	L0.005	L0.005	L0.005	L0.005	L0.005
ALPHA-BHC	0.005	L0.001	0.001	L0.001	L0.001
GAMMA-CHLORDANE	L0.002	L0.002	L0.002	L0.002	L0.002
P,P-'DDE	L0.001	L0.001	L0.001	L0.001	L0.001
O,P'-DDT	L0.001	L0.001	L0.001	L0.001	L0.001
GUTHION	-	-	-	-	-
IMIDAN	-	-	-	-	-
RUELENE	-	-	-	-	-
METHYL PARATHION	-	-	-	-	-
RONNEL	-	-	-	-	-
PHORATE	-	-	-	-	-
TRITHION	-	-	-	-	-
BETA-ENDOSULFAN	L0.003	L0.003	L0.003	L0.003	L0.003
HEPTACHLOR	L0.001	L0.001	L0.001	L0.001	L0.001
LINDANE	L0.001	L0.001	L0.001	L0.001	L0.001
METHOXYCHLOR	L0.01	L0.01	L0.01	L0.01	L0.01
MIREX	L0.001	L0.001	L0.001	L0.001	L0.001

TABLE 9

ATHABASCA RIVER AT ATHABASCA
(all values in ug.L)

	JAN		JAN
2,4-D	L0.004	2,4-DB	L0.009
ALDRIN	L0.001	2,4,5-T	L0.002
AROCLOR 1254	L0.002	2,4-DP	L0.004
AROCLOR TOTAL	L0.002	AROCLOR 1242	L0.002
ALPHA-CHLORDANE	L0.003	AROCLOR 1260	L0.005
P,P'-DDD	L0.002	ALPHA-BHC	0.008
P,P'-DDT	L0.004	GAMMA-CHLORDANE	L0.003
DIELDRIN	L0.002	P,P-'DDE	L0.001
ETHYL GUTHION	L0.2	O,P'-DDT	L0.001
DISULFOTON	L0.02	GUTHION	L0.5
PARATHION	L0.02	IMIDAN	L0.2
MALATHION	L0.05	RUELENE	L0.2
DIAZINON	L0.02	METHYL PARATHION	L0.02
ETHION	L0.02	RONNEL	L0.02
ALPHA-ENDOSULFAN	L0.001	PHORATE	L0.02
ENDRIN	L0.002	TRITHION	L0.02
HEPTACHLOR EPOXIDE	L0.002	BETA-ENDOSULFAN	L0.003
MCPA	L0.2	HEPTACHLOR	L0.001
SILVEX	L0.004	LINDANE	L0.001
HCB	L0.001	METHOXYCHLOR	L0.01
MIREX			

PEACE RIVER BASIN - SMOKY RIVER

At Watino, all parameters, with the exception of phosphorus in Janurary (Table 2), met objectives. Phosphorus concentrations were generally higher than one would expect in a river of this type (cf the Peace R.).

Based on this and other data, it is suspected that these levels may result partly from discharges from the Grande Pairie pulp mill.

Dissolved organic carbon and colour were also higher than expected in a river of this type.

PEACE RIVER BASIN - PEACE RIVER

All parameters met objectives at this site.

TABLE 1

SMOKY AND PEACE RIVERS
(All values in mg/L unless otherwise noted)

SMOKY AT WATINO

	OXYGEN	CONDUCTIVITY (us/cm)	PH (pH units)	TEMPERATURE (Deg C)	TURBIDITY (JTU)	COLOUR (Rel Units)	RESIDUE N.F.
NOV	13.9	NV	8.2	15.6	-	50.	14.
DEC	14.0	480.	8.4	0.0	-	60.	3.
JAN	12.6	NV	7.3	0.0	-	30.	2.
FEB	11.9	NV	NV	0.0	-	60.	20.
MAR	12.0	NV	7.9	0.0	3.9	100.	5.

PEACE AT HWY 2

	OXYGEN	CONDUCTIVITY (us/cm)	PH (pH units)	TEMPERATURE (Deg C)	TURBIDITY (JTU)	COLOUR (Rel Units)	RESIDUE N.F.
NOV	12.3	164.	NV	15.3	4.6	10.	7.
DEC	14.6	162.	8.4	0.0	-	20.	9.
JAN	14.2	NV	8.1	0.0	5.9	5.	4.
FEB	15.4	NV	NV	0.0	2.5	10.	2.
MAR	14.0	NV	8.1	0.0	-	10.	L1.

OBJECTIVE G5.0

TABLE 2

SMOKY AND PEACE RIVERS
(All values in mg.L unless otherwise noted)

SMOKY AT WATINO

	PHOSPHORUS (Total as P)	PHOSPHORUS (Total Soluble)	PHOSPHORUS (Particulate)	NITROGEN (Tot Ammonia as N)	NITROGEN (Diss as N)L
NOV	0.045	0.025	0.020	L0.1	0.18
DEC	0.024	0.012	0.012	L0.1	0.18
JAN	0.14	0.006	0.13	L0.1	0.16
FEB	0.029	0.008	0.021	L0.1	0.19
MAR	0.023	0.019	L0.006	L0.1	0.20

PEACE AT HWY 2

	PHOSPHORUS (Total as P)	PHOSPHORUS (Total Soluble)	PHOSPHORUS (Particulate)	NITROGEN (Tot Ammonia as N)	NITROGEN (Diss as N)L
NOV	0.014	L0.003	0.012	L0.1	0.12
DEC	0.019	0.006	0.013	L0.1	0.03
JAN	0.022	0.003	0.019	L0.1	0.12
FEB	0.007	0.004	L0.006	L0.1	0.14
MAR	0.004	0.003	L0.006	L0.1	0.11

OBJECTIVE 0.05

TABLE 3

SMOKY AND PEACE RIVERS
(All values in mg.L unless otherwise noted)

SMOKY AT WATINO

	NITROGEN (Diss NO_3 + NO_2 as N)	NITROGEN (Total as N)	NITROGEN (Diss as N)F	NITROGEN (Part as N)L	CARBON (Diss Org as C)L
NOV	NV	0.25	-	0.07	5.7
DEC	0.07	0.18	-	L0.01	5.4
JAN	0.07	0.16	-	L0.01	3.9
FEB	0.09	0.29	-	0.10	4.9
MAR	0.10	0.20	-	L0.01	6.1

PEACE AT HWY 2

	NITROGEN (Diss NO_3 + NO_2 as N)	NITROGEN (Total as N)	NITROGEN (Diss as N)F	NITROGEN (Part as N)L	CARBON (Diss Org as C)
NOV	0.02	0.15	-	0.03	2.9
DEC	0.06	0.16	-	0.03	0.25
JAN	0.07	0.12	-	L0.01	2.4
FEB	0.07	0.14	-	L0.01	2.2
MAR	0.05	0.11	-	L0.01	2.4

OBJECTIVE	1.0

TABLE 4

SMOKY AND PEACE RIVERS
(All values in mg.L unless otherwise noted)

SMOKY AT WATINO

	CARBON (Part Org as C)L	PHENOLICS	TOTAL COLIFORMS (no. 100 mL)	FECAL STREPTOCOCCUS (no. 100 mL)	FECAL COLIFORMS (no. 100 mL)
NOV	0.70	NV	72.	G160.	72.
DEC	0.30	0.004	9.	4.	L2.
JAN	0.21	0.002	40.	L2.	L2.
FEB	0.90	NV	10.	L2.	6.
MAR	0.45	0.005	10.	L2.	L2.

PEACE AT HWY 2

	CARBON (Part Org as C)L	PHENOLICS	TOTAL COLIFORMS (no. 100 mL)	FECAL STREPTOCOCCUS (no. 100 mL)	FECAL COLIFORMS (no. 100 mL)
NOV	0.35	0.005	L2.	20.	L2.
DEC	0.25	0.002	18.	4.	4.
JAN	0.20	0.001	12.	L2.	4.
FEB	0.10	NV	37.	L2.	L2.
MAR	0.08	0.002	48.	L2.	1.

OBJECTIVE		0.005	L1000		L200

TABLE 5

SMOKY AND PEACE RIVERS
(All values in mg.L unless otherwise noted)

SMOKY AT WATINO	ALKALINITY	HARDNESS (Total as $CaCO_3$)	MAGNESIUM	CALCIUM	POTASSIUM	SODIUM	SILICA (Reactive)
NOV	164.	191.6	14.2	53.3	1.0	12.	4.0
DEC	200.	246.4	17.7	69.5	1.1	16.	5.7
JAN	200.	244.0	17.4	69.0	1.1	15.	5.4
FEB	200.	247.6	17.0	71.1	1.1	23.	5.6
MAR	192.	247.4	17.5	70.2	1.2	25.	5.2

PEACE AT HWY 2	ALKALINITY	HARDNESS (Total as $CaCO_3$)	MAGNESIUM	CALCIUM	POTASSIUM	SODIUM	SILICA (Reactive)
NOV	95.	96.6	6.6	27.8	0.4	2.0	3.6
DEC	92.	103.9	6.8	30.4	0.5	2.0	4.3
JAN	98.	111.0	7.0	32.9	0.5	1.8	4.5
FEB	95.	102.8	6.7	30.1	0.5	1.7	4.4
MAR	92.	102.5	6.7	30.0	0.5	2.2	4.0

OBJECTIVE	1.5

TABLE 6

SMOKY AND PEACE RIVERS
(All values in mg.L unless otherwise noted)

SMOKY AT WATINO	FLUORIDE	CHLORIDE	SULPHATE	CARBONATE	BICARBONATE	HYDROXIDE	TOTAL DISSOLVED SOLIDS
NOV	0.24	7.3	39.	0.0	199.9	0.0	229.4
DEC	0.17	9.9	56.	0.0	243.8	0.0	296.4
JAN	0.12	5.5	61.	0.0	243.8	0.0	294.8
FEB	0.09	19.	72.	0.0	243.8	0.0	329.3
MAR	0.07	22.	68.	0.0	234.0	0.0	324.8

PEACE AT HWY 2	FLUORIDE	CHLORIDE	SULPHATE	CARBONATE	BICARBONATE	HYDROXIDE	TOTAL DISSOLVED SOLIDS
NOV	0.10	0.6	11.	0.0	115.8	0.0	109.2
DEC	L0.05	0.7	11.	0.0	112.1	0.0	111.2
JAN	L0.05	0.8	11.	0.0	119.5	0.0	117.6
FEB	L0.05	0.8	11.	0.0	115.8	0.0	112.5
MAR	L0.05	0.7	12.	0.0	112.1	0.0	111.5

OBJECTIVE	1.5

TABLE 7

SMOKY AND PEACE RIVERS
(All values in mg.L unless otherwise noted)

SMOKY AT WATINO

	ARSENIC (diss)	BARIUM (total)	BORON (diss)	CADMIUM (total)	COBALT (total)	COPPER (total)	IRON (diss)	LEAD (total)
NOV	L.0005	-	0.06	-	-	-	-	-
DEC	L.0005	-	0.16	-	-	-	-	-
JAN	L.0005	0.14	0.07	L0.001	L0.002	0.001	0.13	L0.004
FEB	L.0005	-	0.11	-	-	-	-	-
MAR	L.0005	-	0.17	-	-	-	-	-

PEACE AT HWY 2

	ARSENIC (diss)	BARIUM (total)	BORON (diss)	CADMIUM (total)	COBALT (total)	COPPER (total)	IRON (diss)	LEAD (total)
NOV	L.0005	-	0.02	-	-	-	-	-
DEC	L.0005	-	0.03	-	-	-	-	-
JAN	L.0005	L0.05	0.04	L0.001	L0.002	L0.001	0.09	L0.004
FEB	L.0005	-	0.04	-	-	-	-	-
MAR	L.0005	-	0.03	-	-	-	-	-

OBJECTIVE	0.01	1.0	0.5	0.1		0.02	0.3	0.05

TABLE 8

SMOKY AND PEACE RIVERS
(All values in mg.L unless otherwise noted)

SMOKY AT WATINO

	MANGANESE (diss)	MERCURY (total-(ug.L)	NICKEL (total)	SELENIUM (diss)	SILVER (extbl)	VANADIUM (total)	ZINC (total)
NOV	-	-	-	L.0005	-	-	-
DEC	-	-	-	L.0005	-	-	-
JAN	0.01	-	L0.002	L.0005	L0.004	L0.001	L0.001
FEB	-	-	-	L.0005	-	-	-
MAR	-	-	-	L.0005	-	-	-

PEACE AT HWY 2

	MANGANESE (diss)	MERCURY total-(ug.L)	NICKEL (total)	SELENIUM (diss)	SILVER (extbl)	VANADIUM (total)	ZINC (total)
NOV	-	-	-	L.0005	-	-	-
DEC	-	-	-	L.0005	-	-	-
JAN	L0.010	-	L0.002	L0.005	L0.004	L0.001	0.002
FEB	-	-	-	L.0005	-	-	-
MAR	-	-	-	L.0005	-	-	-

OBJECTIVE	0.05	0.01		0.01	0.05		0.05

TABLE 9

SMOKY AND PEACE RIVERS
(all values in ug.L)

JAN	SMOKY AT WATINO	PEACE AT HWY 2		SMOKY AT WATINO	PEACE AT HWY 2
2,4-D	L0.004	L0.004	2,4-DB	L0.009	L0.009
ALDRIN	L0.001	NS	2,4,5-T	L0.002	L0.002
AROCLOR 1254	L0.002	NS	2,4-DP	L0.004	L0.004
AROCLOR TOTAL	L0.002	NS	AROCLOR 1242	L0.002	NS
ALPHA-CHLORDANE	L0.003	NS	AROCLOR 1260	L0.005	NS
P,P'-DDD	L0.002	NS	ALPHA-BHC	0.003	NS
P,P'-DDT	L0.004	NS	GAMMA-CHLORDANE	L0.002	NS
DIELDRIN	L0.002	NS	P,P-'DDE	L0.001	NS
ETHYL GUTHION	L0.2	L0.2	O,P'-DDT	L0.001	NS
DISULFOTON	L0.02	L0.02	GUTHION	L0.5	L0.5
PARATHION	L0.02	L0.02	IMIDAN	L0.2	L0.2
MALATHION	L0.05	L0.05	RUELENE	L0.2	L0.2
DIAZINON	L0.02	L0.02	METHYL PARATHION	L0.02	L0.02
ETHION	L0.02	L0.02	RONNEL	L0.02	L0.02
ALPHA-ENDOSULFAN	L0.001	NS	PHORATE	L0.02	L0.02
ENDRIN	L0.002	NS	TRITHION	L0.02	L0.02
HEPTACHLOR EPOXIDE	L0.002	NS	BETA-ENDOSULFAN	L0.003	NS
MCPA	L0.2	L0.2	HEPTACHLOR	L0.001	NS
SILVEX	L0.004	L0.004	LINDANE	L0.001	NS
HCB	L0.001	NS	METHOXYCHLOR	L0.01	NS
MIREX	L0.001	NS			

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